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Dynamics of the Canadian Manufacturing Sector in Metropolitan and Rural Regions

by John R. Baldwin and W. Mark Brown with Tara Vinodrai

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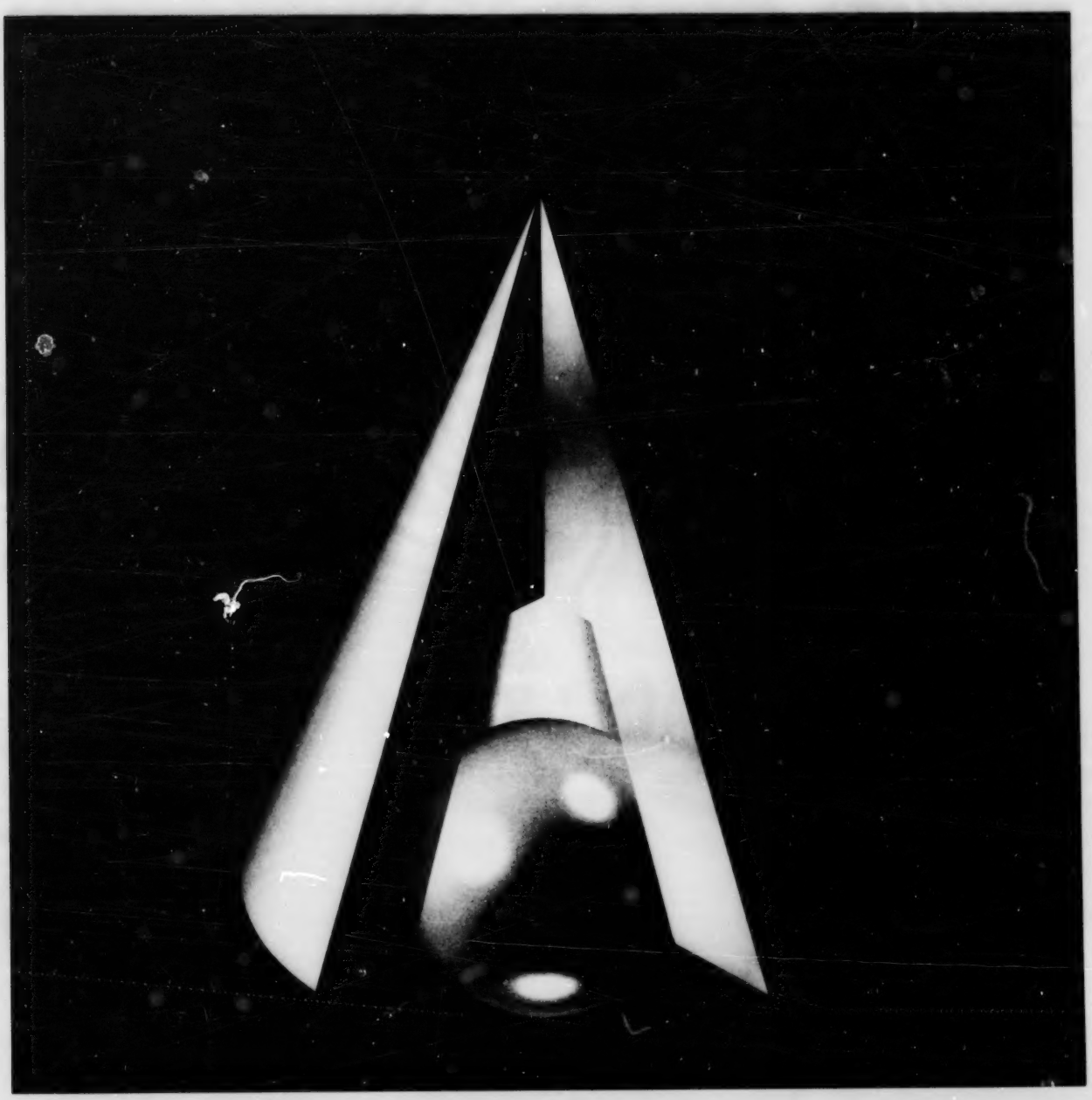

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Abstract

This paper documents the changing geography of the Canadian manufacturing sector over a twenty-two year period (1976-1997). It does so by looking at the shifts in employment, as well as other measures of industrial change, across different levels of the rural/urban hierarchy—central cities, adjacent suburbs, medium and small cities, and rural areas.

The analysis demonstrates that the most dramatic shifts in manufacturing employment were from the central cities of large metropolitan regions to their suburbs. Paralleling trends in the United States, rural regions of Canada have increased their share of manufacturing employment. Rising rural employment shares were due to declining employment shares of small cities and, to a lesser degree, large urban regions. Increasing rural employment was particularly prominent in Quebec, where employment shifted away from the Montreal region. By way of contrast, Ontario's rural regions only maintained their share of employment and the Toronto region increased its share of provincial employment over the period. The changing fortunes of rural and urban areas was not the result of across-the-board shifts in manufacturing employment, but was the net outcome of differing locational patterns across industries.

Change across the rural/urban hierarchy is also measured in terms of wage and productivity levels, diversity, and volatility. In contrast to the United States, wages and productivity in Canada do not consistently decline moving down the rural/urban hierarchy from the largest cities to the most rural parts of the country. Only after controlling for the types of manufacturing industries found in rural and urban regions is it apparent that wages and productivity decline with the size of place. The analysis also demonstrates that over time most rural and urban regions are diversifying across a wider variety of manufacturing industries and that shifts in employment shares across industries—a measure of economic instability—has for some rural/urban classifications increased modestly.

Keywords: manufacturing location, rural economies, urban economies, wages, labour productivity, diversity, and volatility

Executive Summary

It is often argued that new technologies and improvements in transportation are making it easier to decentralize economic activities away from congested mega-cities to smaller cities and rural areas. In contrast, economic geographers have noted that strong centralizing tendencies are associated with the advantages of a large labour pool and advantageous interactions that take place in large cities.

Despite this interest in the changing importance of cities, we know surprisingly little about the changing location of manufacturing production in Canada. To date, no study has systematically attempted to measure the shifting geography of the Canadian manufacturing sector in both rural and urban areas of Canada. This paper fills this gap in our knowledge by tracking the actual course of economic development in the manufacturing sector of Canadian cities over the last quarter century. Using longitudinal data on output and wages, along with a specially constructed fixed geographical code, the paper provides a picture of changes in the manufacturing sector that have occurred across various units in the urban/rural hierarchy—large central cities, their suburbs, medium and small cities, and rural areas.

There are several questions that this paper seeks to answer regarding the location and structure of manufacturing economy in urban and rural parts of Canada:

1) *Has there been a shift from the centre of large urban areas—Toronto, Montreal and Vancouver—to their outlying suburbs or has there also been a shift down the rural-urban hierarchy towards rural areas?*

   - There has been a large shift in manufacturing employment out of the central core of large metro areas—but most of this has been to the large metro suburbs. When both central core and suburbs are considered together, the analysis shows that large cities have only experienced a marginal loss in their share of employment.

   - This shift has continued unabated over the last three decades.

   - The analysis also shows that there has been a small increase in the share of manufacturing employment in rural regions, and this was primarily in those rural areas located adjacent to cities.

   - Looking at Canada as a whole, therefore, there has been no apparent change in the underlying structure of the Canadian economy that favours rural regions over large urban centres or *visa versa*.

2) *Do we observe significant differences between the rural and urban locational trends across different regions, and specifically in Ontario and Quebec?*

   - Ontario and Quebec have experienced contrasting trends in the location of manufacturing production over the study period. Employment in Ontario has tended to concentrate in the Toronto region, particularly in the suburbs surrounding the new City of Toronto. By way of contrast, the Montreal urban area has experienced a fall in its share of Quebec manufacturing employment over the study period. Manufacturing employment in Quebec has concentrated increasingly in rural parts of the province.

3) *Are the shifts in the location of manufacturing production similar across all industries or has it primarily been driven by a subset of industries?*

   - The increasing share of manufacturing employment in the outlying suburbs of large metropolitan regions has been driven by a general shift in production across almost all sectors. The exception is the science-based sector, which has tended to concentrate more and more at the top end of the rural urban hierarchy—that is, in medium sized metropolitan areas and in the fringes of large metropolitan areas.

To examine differences in the character of the economic base provided by rural and urban manufacturing economies in Canada, we compare wage rates and labour productivity across regions as well as the degree to which urban and rural economies differ in their industry specialization and their levels of stability. In particular we ask:

1) *Do production worker wages and labour productivity fall as we move from the largest urban centres to the most remote rural regions, as has been observed in the United States?*

   - The average wage rates in manufacturing are not considerably lower in rural areas than in the central metro areas. This is in marked contrast to the United States where wage rates in rural areas are considerably lower. But this cross-country difference disappears once industry structure is considered. Rural areas tend to have a larger percentage of their employment in industries that pay higher wages. Once industry structure is accounted for, plants in rural areas are found to pay lower wages in Canada.

2) *Are there significant differences in the structure of rural and urban manufacturing economies?*

   - Larger cities are more diversified than smaller cities and rural areas. Larger cities have a wider range of industries. Over time, these differences between smaller and larger cities have narrowed, but only slightly.

- Measures of structural change that capture the extent to which the relative importance of industries is changing show that central urban areas exhibit the most stability despite their overall loss of employment. In contrast, measures of structural change for the fringe areas of large metro regions are very high. This also tends to be the case in rural areas and in small cities.

Overall, this paper shows that much of the shift in the location of manufacturing activity in Canada has occurred within the large metropolitan regions; shifts have occurred from their cores to their fringes. There has been no general shift up or down the rural-urban hierarchy, which would have occurred if lower transportation or communication costs had made locating in smaller urban or rural places more advantageous than locating in large urban centres. The paper also finds wage rates and productivity levels do not generally decline with the size of urban region, which contrasts with patterns observed in the United States. In this sense, workers in smaller urban or rural areas in Canada are not disadvantaged relative to workers in larger urban centres. Workers in small cities and rural areas are, however, more likely to live in places that rely on a few industries and that tend to be less stable than larger urban regions.

Acknowledgements

We would like to thank Professor Ehrensaft of the University of Quebec at Montreal, Tara Vinodrai of Statistics Canada and Robert Campbell of McGill University for their work on the Beale geographic codes used herein. Tara Vinodrai also drafted Appendix A, which describes the methodology used to apply the Beale codes.

1. *Introduction*

Manufacturing firms in Canada operate in a highly competitive environment in which market shares can shift rapidly amongst new, incumbent, and exiting firms (Baldwin, 1995). In such a dynamic environment, there is a large potential for change in the location of industrial employment. Moreover, the changeable fortunes of firms and industries can have a strong affect on the economic structures of local economies, be they large cities or small towns.

Keeping these points in mind, the objectives of this paper are two fold. First, we wish to document the changing geography of the Canadian manufacturing sector over a twenty-two year period (1976-1997) by looking at the shifts in employment across different levels of the rural/urban hierarchy–central cities, adjacent suburbs, medium and small cities, and rural areas. The analysis concentrates on the manufacturing sector because of its central importance in the economic system. While it only accounts for about 20 percent of total employment, it is still one of the largest sectors in most areas.[1] As of 1986 in Canada, the percentage of the rural labour force in manufacturing is only slightly behind the percent in the primary sector (Ehrensaft and Beeman, 1992). In the U.S., manufacturing had replaced agriculture as the primary economic base for much of the U.S. rural mid-west by 1992 (Bernat, 1997). Therefore, even in predominantly rural areas, manufacturing is a significant source of employment.

We seek not only to measure shifts in aggregate manufacturing employment across the rural/urban hierarchy, but also the industrial composition of these changes. That is, we are interested in whether these shifts are broad-based, encompassing a wide selection of industries, or whether they are driven by a small selection of industries. Broad-based change may reflect structural shifts in the economy that favour one or more parts of the rural/urban hierarchy over others. For example, falling transportation and communication costs can make rural parts of the country a more attractive location for manufacturing production (Kilkenny, 1998). On the other hand, change may be more industry specific. Large urban regions may provide the necessary access to skilled workers and specialized suppliers to attract and keep knowledge-based industries. Rural regions may be more attractive to labour-intensive industries because worker wages are often lower in these regions (Kilkenny, 1998).

Second, we are interested in measuring the degree to which the economic structures of rural and urban areas have changed over time. These changes are measured across three dimensions: relative wage and productivity levels, economic diversity, and exposure to economic shocks. For the first dimension, wages and labour productivity, we ask whether there are substantial differences in wage levels and productivity across our geographic areas and in their trends over time. Measuring variation in wages is important because of its relationship to the economic base provided by an industry, while measuring differences in productivity across the rural-urban divide is important because of the close link between productivity and industrial competitiveness (Porter, 1990).

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[1] While services as a whole are more important, it is probably inappropriate to make comparisons to the service sector as a whole. Services contain such diverse production activities as communications, transportation, retailing and wholesaling. Measured in terms of value-added, manufacturing is larger than each of these sectors.

There is considerable evidence from Canada and the U.S. that wages and productivity vary regionally. U.S. rural areas have markedly lower levels of wage rates and labour productivity than more urbanised places (Gale, 1997 and 1998). At the more aggregate geographic scale of U.S. states, there is evidence of substantial and persistent differences in productivity (c.f. Ciccone and Hall, 1996; Rigby and Essletzbichler, 2000). In Canada, there is also strong evidence that labour productivity varies across Canadian provinces (Anderson, 1990; Rigby and Anderson, 1993) and between urban centres (McCoy and Moomaw, 1995). This paper is the first attempt that we are aware of to measure differences in labour productivity and the average wage rate across the entire Canadian rural/urban hierarchy.

In addition to differences in wage and productivity levels, we also seek to describe how these variables change over time, and in the case of productivity, what industries are driving change. Here we are interested in determining whether wages and labour productivity are static over time, following no discernable trend, or whether we observe rural and urban places moving further away from the national average or converging with it. We want to identify these trends because they speak to changing relative standards of living (wages) and changes in the underlying competitiveness (productivity) of rural and urban areas of the country.

The second dimension of structural change is diversity. Here we ask whether there has been significant change in the degree of manufacturing diversity or specialization across various levels of the rural/urban hierarchy. Stability in terms of employment shares can mask whether geographic regions have become more or less specialized. Although regional specialisation can be associated with an increase in incomes and employment (witness Silicon Valley), specialization is sometimes associated with greater risks of economic shocks and resultant higher rates of unemployment (Malizia and Ke, 1993). Jane Jacobs (1969, 1984) has been a strong proponent of the view that diversified cities are the most dynamic.

The third and final dimension of change is instability. Instability arises because of the expansion or contraction of industries, or their entry and exit. We measure both phenomenon here and contrast the extent to which measures of share change at the industry level differ substantially across the rural/urban hierarchy. By measuring instability it is also possible to test informally whether greater economic diversity is positively associated with economic stability in Canada.

The remainder of the paper is organized as follows. Initially, we review recent evidence of the changing location of industrial production in Canada and the United States (Section 2). A description of the methodology for defining the rural/urban hierarchy is then presented (Section 3) and this is followed by a discussion of the results, which focuses on trends in employment shares, wage rates and labour productivity, measures of diversity/specialization and instability across the Canadian rural/urban hierarchy over time (Section 4). A brief conclusion is then included (Section 5).

2. *Changing Geography of Manufacturing Production: Evidence from the United States and Canada*

In the United States, the share of manufacturing employment in older metropolitan areas has declined consistently since the end of the Second World War. The fringes of older metropolitan areas, new metropolitan areas (those counties more recently classified as urban) and rural areas have all gained shares (Nucci and Long, 1996 and 1997). These broad changes across urban and rural categories mask considerable variation at the regional level. Older metropolitan areas in the Northeast and Midwest have seen their shares of national employment fall, while over the same post-war period, the older metro regions' share of employment in the West and South have increased (Nucci and Long, 1996). In recent years, however, even the metro areas in the West and South have experienced falling shares of employment (Nucci and Long, 1997). At the other end of the urban-rural hierarchy, non-metropolitan employment shares in the Midwest and South have increased, while they have remained relatively stable in the West and Northeast (Nucci and Long, 1996 and 1997). In general, there has been a shift away from the Midwest and Northeast towards the South and West and a relative, and at times absolute, decline in manufacturing employment in older metropolitan areas in the United States.

Canada has not experienced the same degree of regional shifts in manufacturing production. Manufacturing output is still concentrated in Ontario and Quebec, which together accounted for 79.1% of manufacturing employment in 1976 and 75.6% in 1997, a moderate decline of 3.5% (see Table 1). Much of Ontario and Quebec's relative decline can be attributed to Alberta's growing share of manufacturing employment. At the metropolitan level in Canada, some have argued that goods production has shifted from larger to smaller metropolitan centres (Coffey, 1994; Coffey and Polèse, 1988). Coffey and Shearmur (1998) have documented the evolving pattern of employment across Canadian urban areas. They find that between 1971 and 1991 cities have diversified their economic bases across service and goods producing industries. However, they find those urban areas that are specialized in manufacturing activities have tended to become even more specialized in manufacturing through time. Left unanswered for Canada is how industrial change in the manufacturing sector has differentially affected rural and urban areas.

Table 1. Total Manufacturing Employment by Region, 1976-1997

	Atlantic Canada[a]	Quebec	Ontario	Prairies[b]	Alberta	British Columbia	Provincial Total
	employment (percent share)						
1976	82,821 (4.8)	523,771 (30.1)	852,510 (49.0)	72,611 (4.2)	66,994 (3.9)	140,534 (8.1)	1,739,241 (100.0)
1977	81,028 (4.8)	499,316 (29.3)	842,374 (49.5)	69,664 (4.1)	67,279 (4.0)	141,720 (8.3)	1,701,381 (100.0)
1978	86,228 (4.8)	522,467 (29.2)	879,613 (49.2)	72,178 (4.0)	73,190 (4.1)	153,025 (8.6)	1,786,701 (100.0)
1979	92,370 (5.0)	534,476 (28.9)	911,910 (49.3)	76,113 (4.1)	76,768 (4.1)	158,698 (8.6)	1,850,335 (100.0)
1980	91,441 (5.0)	526,647 (28.5)	908,123 (49.2)	78,830 (4.3)	80,564 (4.4)	159,417 (8.6)	1,845,022 (100.0)
1981	91,265 (4.9)	524,393 (28.4)	910,126 (49.2)	78,216 (4.2)	85,742 (4.6)	158,491 (8.6)	1,848,233 (100.0)
1982	82,655 (4.9)	480,243 (28.2)	846,524 (49.7)	73,191 (4.3)	79,003 (4.6)	140,145 (8.2)	1,701,761 (100.0)
1983	81,534 (4.9)	474,891 (28.4)	838,519 (50.2)	70,225 (4.2)	72,280 (4.3)	133,128 (8.0)	1,670,577 (100.0)
1984	82,408 (4.8)	484,878 (28.2)	880,825 (51.2)	70,164 (4.1)	71,435 (4.1)	131,863 (7.7)	1,721,573 (100.0)
1985	84,168 (4.8)	490,938 (27.8)	911,371 (51.6)	70,706 (4.0)	74,670 (4.2)	134,660 (7.6)	1,766,513 (100.0)
1986	88,135 (4.9)	503,486 (27.8)	935,188 (51.7)	71,781 (4.0)	76,335 (4.2)	133,384 (7.4)	1,808,309 (100.0)
1987	92,245 (5.0)	520,450 (27.9)	956,220 (51.3)	73,803 (4.0)	78,211 (4.2)	142,481 (7.6)	1,863,410 (100.0)
1988	97,181 (5.0)	538,956 (27.7)	993,196 (51.0)	77,687 (4.0)	86,700 (4.5)	152,215 (7.8)	1,945,935 (100.0)
1989	98,754 (5.0)	524,016 (26.6)	1,016,885 (51.7)	78,094 (4.0)	91,762 (4.7)	158,902 (8.1)	1,968,413 (100.0)
1990	91,061 (4.9)	512,533 (27.4)	945,506 (50.6)	73,093 (3.9)	91,382 (4.9)	154,430 (8.3)	1,868,005 (100.0)
1991	87,208 (5.0)	468,776 (27.0)	878,273 (50.6)	68,258 (3.9)	91,266 (5.3)	142,918 (8.2)	1,736,699 (100.0)
1992	84,916 (5.1)	454,761 (27.2)	828,057 (49.5)	67,848 (4.1)	88,308 (5.3)	148,930 (8.9)	1,672,820 (100.0)
1993	81,152 (4.9)	450,219 (27.4)	803,733 (48.9)	69,118 (4.2)	90,921 (5.5)	148,268 (9.0)	1,643,411 (100.0)
1994	81,550 (4.9)	461,682 (27.7)	812,014 (48.6)	71,908 (4.3)	94,419 (5.7)	147,900 (8.9)	1,669,473 (100.0)
1995	83,318 (4.9)	465,129 (27.1)	841,007 (49.1)	75,333 (4.4)	99,211 (5.8)	150,420 (8.8)	1,714,418 (100.0)
1996	83,474 (4.7)	481,101 (27.1)	867,356 (48.9)	79,288 (4.5)	107,788 (6.1)	156,238 (8.8)	1,775,245 (100.0)
1997	85,295 (4.6)	500,906 (27.2)	890,803 (48.4)	86,359 (4.7)	120,545 (6.6)	156,422 (8.5)	1,840,330 (100.0)

Note: 1) Employment totals may vary slightly from published figures because of data revisions; and 2) Shares may not add to 100 due to rounding.

[a] Atlantic Canada includes Newfoundland, Prince Edward Island, Nova Scotia and New Brunswick.

[b] Prairies include Manitoba and Saskatchewan.

Source: Annual Survey of Manufactures, special tabulation

3. Methodology

3.1 Measuring the Canadian rural/urban hierarchy: Beale codes

In this paper, we ask whether smaller cities or rural areas have become more important over time, because of the gradual shift of industry out of large metro centres down the rural/urban hierarchy chain. This requires a classification system of the rural/urban hierarchy that can be consistently applied over time. For this purpose, we use a modified version of the Beale rural-urban coding system that was originally developed by the U.S. Department of Agriculture to identify the 'location' of counties within the rural-urban continuum or what might be roughly considered the rural/urban hierarchy (see GAO, 1989; Butler, 1994).[2] Our Beale coding system originally consisted of eleven categories of rural and urban places and uses census divisions, which are largely equivalent to U.S. counties, as its base geographic unit.[3] For the purpose of this paper, we have collapsed these eleven categories into six. We have done so for ease of exposition and because many of the rural classifications include few plants, which would have resulted in the suppression of some of our results in order to preserve the confidentiality of respondents. The six categories are summarized in Table 2.

The Beale coding system classifies census divisions based on their relationship to the Canadian rural/urban hierarchy as defined by the size of Census Metropolitan Areas (CMAs) and Census Agglomerations (CAs) that they encompass or in which they are included. The census divisions are classified first by whether they belong to a metropolitan area and then by the population of that metropolitan area. Outside the metropolitan area, they are classified on the basis of their location relative to metropolitan regions (e.g., Nonmetro-Adjacent versus Nonmetro-Nonadjacent) (see Table 2). Therefore, the Beale coding system contains both hierarchical (size) and geographic (location) components. It provides us with a perspective on the influence of location and position within the rural/urban hierarchy on industrial change.

Figure 1 illustrates the geographic pattern of the Beale coded census divisions for 1976. There were three Large Metro classified census divisions in that year, Montreal, Toronto and Vancouver. Associated with each of these are counties that overlap or are encompassed within their CMA boundaries, the Large Metro Fringe. More numerous are Medium Metro and Small Metro areas, which are found in all provinces except for Prince Edward Island. Medium Metro areas include cities like Halifax, Ottawa, and Calgary. Small Metro areas include cities like Fredericton (New Brunswick), Kingston (Ontario), or Kelowna (British Columbia). Often bordering metropolitan areas are rural Nonmetro-Adjacent classified census divisions. Note, however, that census divisions are classified Nonmetro-Adjacent only if they border on a CMA or CA boundaries and hence, the large number of cases where census divisions are classified as Nonmetro-Nonadjacent census divisions (see Figure 1). Nonmetro-Nonadjacent are the most common census divisions, which cover most of Canada's landmass.

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[2] See McGranahan et al. (1986) for a US comparison of social and economic characteristics by Beale code classes.
[3] For their application to Canada, see Ehrensaft and Beeman (1992).

Table 2. Description of Beale coding system

Code	Name	Description
0	Large Metro	Central and most populous census division of a CMA with a population greater than 1 million
1	Large Metro Fringe	Remaining census division(s) within or partially within a CMA with a population greater than 1 million
2	Medium Metro	Census division(s) containing, within, or partially within a CMA with a population between 250,000 and 999,999
3	Small Metro	Census division(s) containing, within or partially within a CMA/CA with a population between 50,000 and 249,999
4	Nonmetro-Adjacent	Census divisions that share a boundary with a CMA/CA and the CMA has to have a population greater than 50,000
5	Nonmetro-Nonadjacent	Census divisions that *do not* share a boundary with a CMA/CA that has a population greater than 50,000

Note: Because CMA and CA boundaries are different than census division boundaries, census divisions may: (1) contain entire CMA/CAs; (2) be found completely within CMA/CA boundaries; or (3) be only partially within the territory of a CMA or CA. In all cases, the census division is classified using the Beale code that is associated with the size of that CMA/CA.

Initially, census divisions were given Beale codes based on their population characteristics and relative locations for each of the census years 1976, 1981, 1986 and 1991.[4] As towns or smaller metro areas grow larger, their Beale codes change over time. In effect, census divisions move up the rural/urban hierarchy. However, for some types of longitudinal analysis, this reclassification can be a problem.

The primary objective of this paper is to measure change in the location and composition of industry through time. Therefore, it is important for our purposes to be able to distinguish between two forces that have been behind the change in manufacturing activity across Canada's rural/urban hierarchy: change that results from the growth or decline of industry and change that results from the reclassification of census divisions. Allowing the classification of census divisions to change hampers the interpretation of changes in the importance of economic activity across different geographic units because of resulting discontinuities at the census years. It means that changes in the importance of manufacturing in a particular area can be caused either by inherent growth in that region or by reclassification. For example, growth in metro fringe areas can be caused either by the fact that industry in these areas was inherently more dynamic or because smaller metro or rural areas were being reclassified or absorbed into metropolitan areas. Since we want to know, for example, the extent to which industry that was in rural regions at the beginning of the period grew more or less quickly than industry that was in larger centres, we need to remove the effect of reclassification on our measures of changing activity. To do so, it is important that we be able to hold the original classification constant since 1976—the start of our study.

[4]For intercensus years, codes remained fixed based on their classification from the previous census.

To hold the classification of census divisions constant through time, two problems had to be resolved. First, through the study period many census divisions across Canada grew in size, resulting in their reclassification and, at times, those of their neighbours.[5] Second, the boundaries of census divisions have not been constant over time. This is particularly true of census divisions in Quebec, which were completely redrawn in 1991.

We have taken two steps to overcome these difficulties. First, for those census divisions whose borders have not changed over time, we have maintained their 1976 classification constant throughout the study period. This eliminates the reclassification problem. When a census division's borders changed we followed a more complicated procedure. In cases where census divisions were split, we combined them together to match their 1976 boundaries. In the few instances where census divisions were amalgamated, we adopted the new, rather than 1976, boundaries. In many instances, census division boundaries were completely redrawn, which made it impossible to recombine them to recreate earlier or later census geographies. To address this problem, plants were assigned point locations using postal codes. The point locations, in turn, were used to allocate plants to the 1976 census geography. A detailed discussion of the procedures we used can be found in Appendix A.

3.2 Measuring change in the rural/urban hierarchy

As we have noted above, one of the objectives of this paper is to measure various dimensions of change within the Canadian rural/urban hierarchy. In this sub-section, we review several measures of change that are related to productivity, specialization and turnover or turbulence within the economic system.

1. Wage rates and labour productivity

In this paper, wage rates are measured as the wages paid per production worker on an annualized basis. Productivity is measured as value added per worker, a form of labour productivity. Changes in labour productivity can be caused either by changes in technology[6] or increases in the capital intensity of an industry. Similarly, differences in labour productivity across geographic areas can be caused by differences in efficiency or differences in capital intensity. We do not try to disentangle these two causes in this paper.

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[5]For example, the reclassification of a Nonmetro-Nonadjacent census division to small metro might also result in the reclassification of those census divisions that border its new CA boundaries to be reclassified from Nonmetro-Nonadjacent to Nonmetro-Adjacent.

[6] We define technological change broadly to include those factors internal to the firm (e.g., incorporation of more efficient machinery) and those external to the firm (e.g., changes in the worker skills) that influence productivity outside of changes in the capital/labour ratio.

2. *Measures of Industry Concentration*

The specialization measures focus on whether a region's output is concentrated in a relatively narrow set of industries. There are two measures of industry concentration. The first is the *Top Four Industry Concentration Index.* It is defined as $Con4_i = \sum_{j=1}^{4} s_{ij}$ or the share of the top four industries in terms of employment, where s_{ij} is the share of industry i's employment in region j. This measure is a simple four-industry concentration ratio, which captures the percent of a region's employment that is accounted for by the largest four industries. It varies from 4/n, where n is the number of industries in a region to 1. The lower bound occurs when all industries are equally important. The upper bound occurs when four or fewer industries account for all employment.

The second measure is the *Herfindahl Measure of Concentration.* It is defined as the sum of the squared shares of each industry; that is, $HI_i = \sum_{j=1}^{n} s_{ij}^2$. It varies from 1/n, when all industries have the same share, to 1, when the largest accounts for all employment. Contrary to the first measure, the Herfindahl index considers the entire distribution of employment shares across all industries and not just the most important four industries.

3. *Measures of Industry Share Change*

Measures of industry specialization provide us with an external picture of its outward structure. The final set of measures examines the amount of dynamic change within a region. A region may look relatively stable using a concentration measure but have a great deal of underlying change. For example, in two adjacent periods, the four-industry concentration ratio may be the same, but the identity of the four most important industries may have changed completely.

The measure of industry share change simply sums up all the absolute value of changes in industries' shares between two periods and divides by two. The latter is done to account for the fact that all growth in market share must be offset by a decline in share, and thus dividing by 2 avoids double counting. This measure of industrial change is defined as the *Industry Share Change Index (ISC)* $= \sum_{j=1}^{n} \left| s_{ij,t+1} - s_{ij,t} \right| \Big/ 2$, where t refers to the year. The ISC can be seen as a measure of instability.

4. Results

4.1 The changing industrial structure of the Canadian rural/urban hierarchy

At issue is the extent to which there have been dramatic shifts in the location of production across different levels of the rural/urban hierarchy over the last twenty-two years. In particular, can we see the same loss of importance in the urban centres in Canada as the United States? If yes, how has the deterioration in the relative size of these central urban centres been matched by corresponding growth in the major urban suburbs or has the decline been associated with growth of small metropolitan areas? Have rural areas also suffered a decline or have they benefited from the decline in the relative size of the urban core?

We address these questions by observing changes in manufacturing employment across the rural/urban hierarchy. An alternative metric that can be used to measure importance is shipments, which measure the extent that regions are more or less successful in capturing market share. The two metrics do not always move together. A geographic region's share of shipments may go up and its employment share go down if its industries are becoming relatively more productive than other regions. In order to keep the presentation concise, we only present employment trends in this section. In the next section, we report trends in relative productivity across the rural/urban hierarchy, which is an indirect measure of changes in shipment shares.

We divide this sub-section into three parts. The first reviews the broad trends in employment and employment shares experienced by Canada's urban and rural areas. Since national trends can mask significant regional differences, the second section looks into employment changes across the rural/urban hierarchy in Canada's two most important manufacturing regions, Ontario and Quebec. In the third part, we break down employment by industry. Here we wish to determine whether shifting employment shares are driven by a few industries or whether we are observing across-the-board shifts in manufacturing employment.

Table 3. Total Employment by Beale Code, 1976-1997

	Large Metro (0)	Large Metro Fringe (1)	Medium Metro (2)	Small Metro (3)	Nonmetro-Adjacent (4)	Nonmetro-Nonadjacent (5)	Total[a]
	employment (percent share)						
1976	595,746 (34.2)	175,625 (10.1)	324,465 (18.7)	261,090 (15.0)	179,639 (10.3)	203,035 (11.7)	1,739,600 (100.0)
1977	571,773 (33.6)	173,098 (10.2)	317,075 (18.6)	263,130 (15.5)	176,695 (10.4)	199,860 (11.7)	1,701,631 (100.0)
1978	596,521 (33.4)	186,463 (10.4)	330,631 (18.5)	267,737 (15.0)	190,522 (10.7)	215,146 (12.0)	1,787,020 (100.0)
1979	614,004 (33.2)	200,680 (10.8)	342,597 (18.5)	269,152 (14.5)	199,788 (10.8)	224,594 (12.1)	1,850,815 (100.0)
1980	611,881 (33.2)	201,929 (10.9)	347,527 (18.8)	264,351 (14.3)	195,894 (10.6)	223,925 (12.1)	1,845,507 (100.0)
1981	611,645 (33.1)	202,849 (11.0)	349,033 (18.9)	265,173 (14.3)	196,844 (10.6)	223,129 (12.1)	1,848,673 (100.0)
1982	572,013 (33.6)	184,912 (10.9)	323,157 (19.0)	243,254 (14.3)	176,571 (10.4)	202,265 (11.9)	1,702,172 (100.0)
1983	558,223 (33.4)	192,452 (11.5)	306,960 (18.4)	238,325 (14.3)	175,906 (10.5)	199,140 (11.9)	1,671,006 (100.0)
1984	563,854 (32.7)	210,723 (12.2)	315,333 (18.3)	241,142 (14.0)	185,452 (10.8)	205,417 (11.9)	1,721,921 (100.0)
1985	573,851 (32.5)	226,995 (12.8)	321,311 (18.2)	246,124 (13.9)	188,507 (10.7)	210,057 (11.9)	1,766,845 (100.0)
1986	584,077 (32.3)	236,935 (13.1)	327,650 (18.1)	250,049 (13.8)	194,569 (10.8)	215,496 (11.9)	1,808,776 (100.0)
1987	598,313 (32.1)	247,426 (13.3)	335,702 (18.0)	257,060 (13.8)	201,387 (10.8)	223,878 (12.0)	1,863,766 (100.0)
1988	619,923 (31.9)	267,301 (13.7)	351,621 (18.1)	266,453 (13.7)	211,298 (10.9)	229,743 (11.8)	1,946,339 (100.0)
1989	617,774 (31.4)	281,155 (14.3)	361,263 (18.3)	265,688 (13.5)	212,584 (10.8)	230,405 (11.7)	1,968,869 (100.0)
1990	588,573 (31.5)	270,848 (14.5)	341,118 (18.3)	248,524 (13.3)	201,829 (10.8)	217,574 (11.6)	1,868,466 (100.0)
1991	542,169 (31.2)	246,945 (14.2)	323,249 (18.6)	233,815 (13.5)	187,827 (10.8)	203,150 (11.7)	1,737,155 (100.0)
1992	514,793 (30.8)	240,953 (14.4)	311,122 (18.6)	221,338 (13.2)	183,674 (11.0)	201,434 (12.0)	1,673,314 (100.0)
1993	494,154 (30.1)	239,361 (14.6)	304,308 (18.5)	217,784 (13.2)	186,592 (11.4)	201,641 (12.3)	1,643,840 (100.0)
1994	489,702 (29.3)	244,271 (14.6)	309,644 (18.5)	225,011 (13.5)	194,107 (11.6)	207,192 (12.4)	1,669,927 (100.0)
1995	494,194 (28.8)	253,300 (14.8)	319,692 (18.6)	234,064 (13.6)	200,841 (11.7)	212,783 (12.4)	1,714,874 (100.0)
1996	502,040 (28.3)	273,042 (15.4)	329,521 (18.6)	241,426 (13.6)	207,156 (11.7)	222,563 (12.5)	1,775,748 (100.0)
1997	507,127 (27.5)	290,923 (15.8)	345,986 (18.8)	250,089 (13.6)	215,890 (11.7)	230,908 (12.5)	1,840,923 (100.0)

Note: Shares may not add to 100 due to rounding.

[a] Total manufacturing employment levels across Beale categories will differ slightly from provincial totals in Table 1 because manufacturing employment in census divisions found in the territories are included in this table.

1. National Employment Trends

We analyse employment trends in two ways—first, by both reporting their levels and shares of employment across the Beale categories over time (Table 3), and second, by testing whether the employment share trends evident in Table 3 are statistically significant (Table 4). We test for two types of trends, linear and non-linear (quadratic). If the trend is linear, the regression coefficient on the TREND[7] variable and its level of statistical significance is reported. However, if the trend is non-linear we report the slopes and statistical significance for two variables, TREND and TRENDSQ[8] (see Table 4). We define non-linearity narrowly here as *only* those cases where TREND and TRENDSQ are significant and take on opposite signs. A negative parameter for TREND and a positive one for TRENDSQ indicates that the slope of the employment share trend is increasing over time and possibly an initial negative trend may have reversed itself by the end of the period. Similarly, if TREND is positive and TRENDSQ is negative, the slope of the Beale category's share is falling over time and potentially an initially positive trend may have been reversed. We should add that any trend reversal seen in the data may be confirmed by TREND and TRENDSQ taking on opposite signs, but such a reversal cannot be identified based on the TREND and TRENDSQ parameter estimates alone. Throughout the rest of the paper we employ this methodology to test the statistical significance of trends, either in separate tables or in the data tables themselves.

Between 1976 and 1997, the most dramatic change in employment share occurred in the Large Metro areas. Employment share in the cores of Canada's large metropolitan areas fell from 34.2% to 27.5%. In contrast, the Large Metro Fringe increased its share consistently over the period, rising from 10.1% to 15.8% (see Tables 3 and 4). Taken together, the Large Metro and Large Metro Fringe's share of employment changed little over the period. It increased from 44.3% to 46.6% in 1990, but then declined to 43.3% in 1997. Therefore, although there have been major shifts within Canada's largest metropolitan regions from their cores to their suburbs, these regions taken together have not experienced a serious decline in their share of manufacturing employment relative to smaller urban and rural areas.

It should be kept in mind that the suburbanisation of manufacturing employment experienced by large urban centres may also be occurring in smaller centres as well. However, we cannot observe these trends because our geographic units—census divisions—are too large to discern such small geographic shifts in employment.

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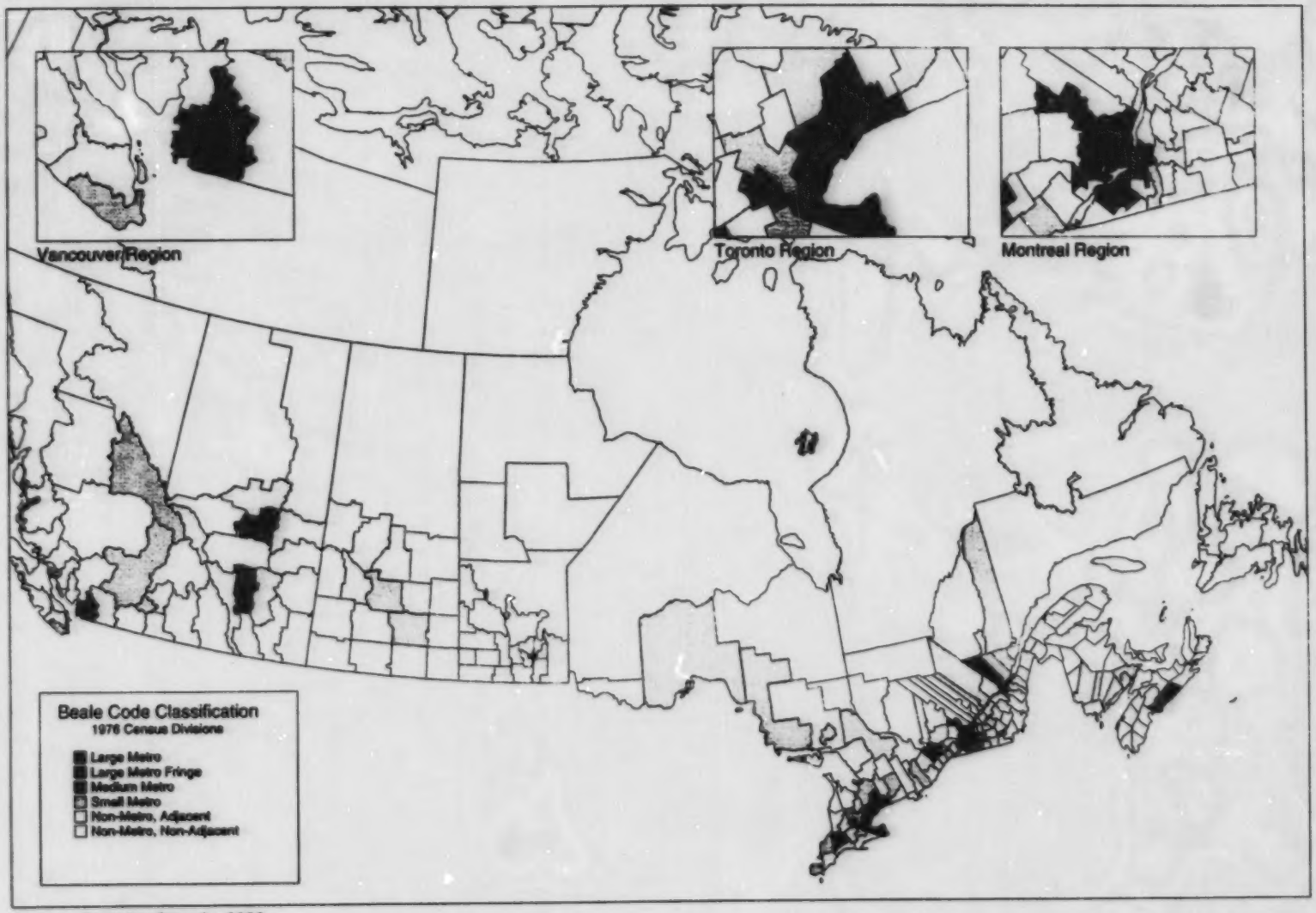
[7] The linear model is specified as follows: $Y = a + bTREND + \varepsilon$, where Y is the variable whose trend we are analysing and TREND is a time based variable, which starts at 1 for 1976 and increases by 1 for every subsequent year of the study.

[8] The non-linear model is specified as $Y = a + bTREND + cTRENDSQ + \varepsilon$, where TRENDSQ is simply TREND squared. By including TRENDSQ in the regression equation, we are able to determine whether there is a non-linear (quadratic) relationship between time and the Y variable.

Figure 1. Beale Code Map



Source: Statistics Canada, 2000

Table 4. Trend Analysis of Employment Shares, Preferred Models

Beale Code	CONSTANT		TREND		TRENDSQ		r^2	n
Large Metro (0)	34.8884	(0.0000)	-0.2749	(0.0000)			0.89	22
Large Metro Fringe (1)	9.6552	(0.0000)	0.2812	(0.0000)			0.96	22
Medium Metro (2)	18.9190	(0.0000)	-0.0980	(0.0064)	0.0041	(0.0070)	0.33	22
Small Metro (3)	15.5290	(0.0000)	-0.2315	(0.0000)	0.0064	(0.0000)	0.93	22
Nonmetro-Adjacent (4)	10.2189	(0.0000)	0.0587	(0.0000)			0.76	22
Nonmetro-Nonadjacent (5)	11.7568	(0.0000)	0.0227	(0.0102)			0.29	22

Note: p-values are in parentheses.

For most of the smaller urban and rural classifications, we also observe significant, albeit smaller, shifts in employment than the Large Metro and Large Metro Fringe (see Tables 3 and 4). Medium Metro was the exception. Its share was the same at the beginning and end of the study period, although it did lose some of its share in the middle. The share of employment in Small Metro areas fell significantly through most of the study period, in relative and absolute terms. On the other hand, the two rural categories gained employment and employment shares between 1976 and 1997 (see Tables 3), with employment share increases being stronger for the Nonmetro-Adjacent category (see Table 4).

It is important to distinguish between the employment trends in Nonmetro-Adjacent and Nonmetro-Nonadjacent areas. Nonmetro-Adjacent areas consistently increased their employment share, while any shifts in employment towards Nonmetro-Nonadjacent did not occur until the mid to late 1990s (see Tables 3 and 4). Therefore, although there has been an apparent shift towards rural manufacturing employment, this trend has been strongest in rural regions that are in the shadow of metropolitan areas. Employment may be moving out of urban regions, but it is not moving that far away.

Overall, these results show that the relative and absolute decline of the cores of Canada's largest metropolitan regions has coincided with increasing employment and employment shares in the suburbs of these cities, rather than a large shift in employment down the rural/urban hierarchy towards smaller metropolitan and rural regions. The growing importance of rural employment observed over the period—which is consistent with trends observed in the U.S. (Nucci and Long, 1996 and 1997) —was the result of the small relative decline of large urban regions combined with the declining shares of small metropolitan areas. In short, manufacturing employment remains concentrated in Canada's largest metropolitan regions and, outside of these regions, it is the rural parts of the country that have experienced growing manufacturing employment.

2. *Regional Employment Trends*

In the United States, Nucci and Long (1996 and 1997) have found that shifts in manufacturing production across the rural/urban hierarchy vary considerably depending on the region under study. By implication, the national shifts in employment and employment shares across the rural/urban hierarchy that we have documented to this point may obscure significant regional differences. To explore this possibility, we compare employment trends in Ontario and Quebec. We focus on these provinces for two reasons. First, Ontario and Quebec together account for three-quarters of Canada's manufacturing employment (see Table 1), and therefore, they have a strong influence on the national trends. Second,

Ontario and Quebec have the most diverse urban structures of all the provinces (see Figure 1), which permits us to compare trends across all rural/urban classifications.

Employment trends by Beale classification are reported for Ontario and Quebec in Table 5. In the table we break the study period into three shorter periods that correspond to the business cycles the Canadian economy experienced since 1976: 1976-1980; 1981-1989; and 1990-1997. For each period, the *average* level of employment and its share of *average* total employment are reported by Beale category and industry. We also report employment levels for the beginning and end years of the study period.

There are substantial differences between the rural/urban hierarchies in Ontario and Quebec, in terms of the weights of their components and their underlying dynamics. The most apparent difference is the top-heavy nature of Quebec's rural/urban hierarchy compared to that of Ontario's. In both provinces, there is one Large Metro classified census division (see Figure 1), the Island of Montreal in Quebec and the new City of Toronto (formerly Metro Toronto) in Ontario. In 1976, the Large Metro core of Toronto accounted for 31.5% of manufacturing employment in Ontario, while the Large Metro core of Montreal accounted for about 49.2% of employment in Quebec (see Table 5). Although both trend downward over time, the decline is some 10 percentage points in Quebec and only about 5 percentage points in Ontario. The Island of Montreal has experienced a much more dramatic relative decline than the central core of Toronto. Moreover, the relative decline of Montreal's urban core has been steady throughout the study period. Toronto's core only experienced a falling share of employment in the 1990s (see Table 5). In contrast to their urban cores, the fringes of Toronto and Montreal grew both in absolute and relative terms. But the Large Metro Fringe in Ontario increased its share of employment by 10.1 percentage points, while it only increased by 3.5 percentage points in Quebec between 1976 and 1997 (see Table 5).

The employment trends experienced by the Large Metro and Large Metro Fringe in Ontario and Quebec reflect the differing fortunes of the Toronto and Montreal metropolitan regions. That is, when added together, the Large Metro and Large Metro Fringe census divisions in both provinces form what we might call the Toronto and Montreal "city-regions".[9] The Toronto city-region share of employment in Ontario increased from 45.6% to 50.5% over the study period (see Figure 2). Toronto increased its share of manufacturing employment until 1990 and then experienced a slight decline, which corresponded with sharp employment losses after 1989. Toronto's gains through the 1970s and 1980s were at the expense of all other rural/urban categories, except Nonmetro-Adjacent (see Table 5).

Unlike Toronto, Montreal's share of employment fell consistently over the period, from 59.6% in 1976 to 52.3% in 1997 (see Figure 2). Montreal's falling share was the result of declining employment in the Montreal region and increasing employment in rural regions of Quebec (see Table 5). Combined, the Nonmetro-Adjacent and Nonmetro-Nonadjacent categories increased their employment shares in Quebec by 8.9% between 1976 and 1997. In Ontario, these rural region's shares remained essentially static.

[9]The city-region metropolitan area boundaries used here do not correspond precisely to the standard Census Metropolitan Area (CMA) boundaries. Consequently, the results presented here are not directly comparable to other published information that is based on the Toronto and Montreal CMA boundaries.

Table 5. Total Employment by Beale Code and Region, Selected Periods

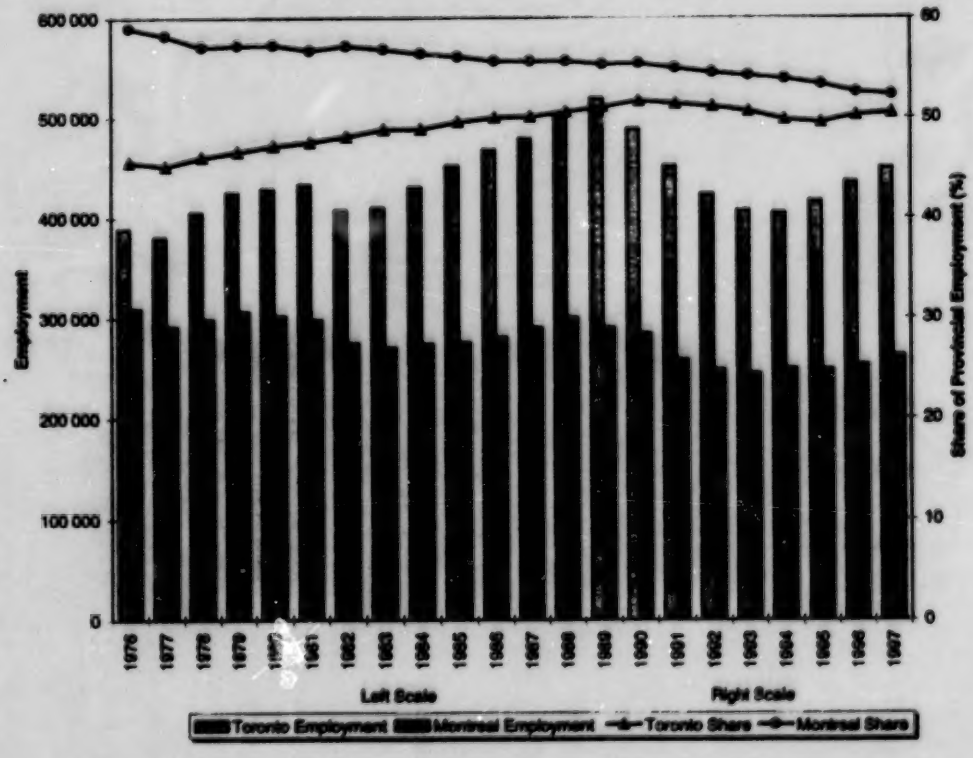
Period	Large Metro (0)		Large Metro Fringe (1)		Medium Metro (2)		Small Metro (3)		Nonmetro-Adjacent (4)		Nonmetro-Nonadjacent (5)		Total	
	employment (percent share)													
Canada														
1976	257,567	(49.2)	51,491	(9.8)	27,548	(5.3)	55,098	(10.5)	60,327	(11.5)	71,740	(13.7)	523,771	(100.0)
1976-80	247,291	(47.4)	53,885	(10.3)	27,567	(5.3)	55,967	(10.7)	62,464	(12.0)	74,162	(14.2)	521,335	(100.0)
1981-89	224,877	(44.6)	58,535	(11.6)	26,290	(5.2)	52,415	(10.4)	65,440	(13.0)	77,137	(15.3)	504,695	(100.0)
1990-97	195,297	(41.2)	60,243	(12.7)	24,821	(5.2)	46,760	(9.9)	67,065	(14.1)	80,203	(16.9)	474,388	(100.0)
1997	195,341	(39.0)	66,507	(13.3)	23,522	(4.7)	49,956	(10.0)	75,564	(15.1)	90,016	(18.0)	500,906	(100.0)
TREND			Negative***		Positive***				Negative***		Positive***		Positive***	
TRENDSQ					Negative*		No Trend							
Ontario														
1976	268,281	(31.5)	120,102	(14.1)	192,964	(22.6)	149,033	(17.5)	82,050	(9.6)	40,080	(4.7)	852,510	(100.0)
1976-80	276,633	(31.5)	128,684	(14.6)	196,350	(22.3)	149,271	(17.0)	85,799	(9.8)	42,171	(4.8)	878,906	(100.0)
1981-89	292,748	(31.8)	162,539	(17.6)	192,095	(20.9)	143,139	(15.6)	88,090	(9.6)	42,373	(4.6)	920,984	(100.0)
1990-97	245,195	(28.5)	189,068	(22.0)	171,155	(19.9)	129,161	(15.0)	87,027	(10.1)	36,739	(4.3)	858,344	(100.0)
1997	234,160	(26.3)	215,183	(24.2)	171,588	(19.3)	139,174	(15.6)	91,899	(10.3)	38,799	(4.4)	890,803	(100.0)
TREND			Positive***		Positive***		Negative***		Negative***		Negative**		Negative***	
TRENDSQ			Negative**				Positive**		Positive***		Positive***			

Note: Shares may not add to 100 due to rounding. *indicates significance at the 5% level, **indicates significance at the 1% level and *** indicates significance at the 0.1% level.

In summary, we find that Large Metro regions in both Ontario and Quebec have lost manufacturing employment in absolute and relative terms, which is consistent with the national trends that we have already observed. However, the two provinces differ in many other respects. In particular, Quebec has experienced a large shift in employment away from the Montreal city-region towards the rural parts of the province, while employment in Ontario has concentrated in the Toronto region at the expense of almost all other rural/urban categories. In other words, Toronto's suburbs have drawn employment away not only from its core, but also other rural and urban regions. Montreal's fringe, on the other hand, has not been as dynamic. It is the rural parts of Quebec that have grown the most.

Why Montreal and Toronto have followed such different paths since 1976 is beyond the scope of this paper. Vinodrai (2001) analyses in greater detail the changing industrial structures of Montreal and Toronto, as well as Vancouver. She finds that part of the reason why Montreal and Toronto followed such different trajectories was differences in their industrial structures. Montreal has experienced large job losses in labour intensive industries, like clothing and textiles, while growing employment in industries such as aerospace have not been enough to compensate. Toronto, on the other hand, was not as specialized in the labour intensive industries. Differences in the industrial structures of Toronto and Montreal do not explain the whole story. Often for the same industries Montreal experienced declining employment and Toronto the opposite, which is an indication that Toronto was more successful at attracting investment capital.

Figure 2. Toronto and Montreal Employment Trends, 1976-1997



3. *Changes in Industrial Structure*

As we have demonstrated above, measuring changes in manufacturing employment on a national basis across the rural/urban hierarchy may hide considerable regional differences. Similarly, looking only at changes in aggregate manufacturing employment may mask variation in the types of industries found in rural and urban places over time; that is, changes in their industrial structure. In essence, we are interested in answering the following question: Are the shifts that we have observed across the rural/urban hierarchy driven by a broad spectrum of manufacturing industries or are they being driven by just a few industries, whose growth or decline may have a particularly strong effect on some rural/urban categories? If it is the former, we may conclude that there is a basic shift from one geographic region to another that depends on the general attractiveness of the region and is not related to the fortunes of one particular industry. If it is the latter, it is more appropriate to study the causes of the growth and decline of particular industries to understand the reasons for the growth of certain regions.

In order to study whether there are underlying differences in the broad trends that we have observed so far, we break the manufacturing sector down into five sectors[10]—labour-intensive, natural resource-based, scale-based, product differentiated and science-based.[11] The five groups are distinguished on the basis of the primary factors affecting the competitive process in each sector. For the resource-based sector, the primary factor affecting the competitive process is access to natural resources. These are industries in which the ratio of value-added to materials inputs is small because there is little value added beyond the raw materials stage. For the labour-intensive sector, the primary factor is labour costs. These industries pay relatively low wages. For the scale-intensive sector, the primary factor is the existence of scale economies. These are industries that are capital intensive. They include both iron and steel, which are concentrated in urban areas, and forest industries, which are based in rural areas. For product-differentiated industries, the primary factor is the ability to tailor production to highly varied demand conditions. These tend to be industries with higher advertising/sales ratios. For science-based industries, the primary factor is the rapid application of scientific advances. These tend to be industries with higher R&D/sales ratios.

[10]See Baldwin and Rafiquzzaman (1994) for a discussion of the definition of these sectors.

[11] In this paper, industry classifications are held constant for the first year of entry of the plant rather than allowing each plant's classifications to change over the period. Consequently, statistics reported by industrial sector may differ slightly from those published elsewhere.

Table 6. Total Employment by Beale Code and Industry, Selected Periods

Period	Large Metro (0)	Large Metro Fringe (1)	Medium Metro (2)	Small Metro (3)	Nonmetro-Adjacent (4)	Nonmetro-Nonadjacent (5)	Total
	period average (percent share)						
1976-80	597,985 (33.5)	187,559 (10.5)	332,459 (18.6)	265,092 (14.9)	188,508 (10.6)	213,312 (11.9)	1,784,915 (100.0)
1980-89	588,853 (32.5)	227,861 (12.5)	332,448 (18.4)	252,585 (14.0)	193,680 (10.7)	215,503 (11.9)	1,810,930 (100.0)
1990-97	516,594 (29.7)	257,455 (14.8)	323,080 (18.6)	234,006 (13.4)	197,240 (11.3)	212,156 (12.2)	1,740,531 (100.0)
1976-80	156,116 (34.0)	39,921 (8.7)	76,049 (16.6)	67,619 (14.7)	49,365 (10.8)	69,890 (15.2)	458,960 (100.0)
1981-89	151,779 (32.3)	49,686 (10.5)	76,514 (16.3)	66,032 (14.1)	52,206 (11.1)	74,008 (15.7)	470,225 (100.0)
1990-97	140,288 (29.8)	62,180 (13.2)	79,551 (16.9)	61,022 (13.0)	53,460 (11.3)	74,552 (15.8)	471,052 (100.0)
TREND		negative***	positive***	negative**	negative***	positive***	positive***	
TRENDSQ		negative*	-	positive**	-	-	-	
1976-80	170,079 (44.6)	30,102 (7.9)	67,275 (17.6)	41,581 (10.9)	42,137 (11.0)	30,290 (7.9)	381,464 (100.0)
1981-89	159,740 (43.0)	36,798 (9.8)	66,130 (17.8)	40,025 (10.8)	39,115 (10.5)	30,474 (8.2)	372,284 (100.0)
1990-97	126,056 (38.9)	38,181 (11.8)	61,329 (19.0)	35,966 (11.1)	33,827 (10.5)	28,296 (8.7)	323,654 (100.0)
TREND		-	positive***	positive***	negative**	negative**	-	
TRENDSQ		negative***	-	-	positive***	positive**	positive**	
1976-80	124,213 (21.5)	63,291 (10.9)	121,390 (21.0)	109,803 (19.0)	67,647 (11.7)	92,699 (16.0)	579,043 (100.0)
1981-89	122,505 (21.3)	73,185 (12.7)	116,160 (20.2)	103,512 (18.0)	70,478 (12.2)	89,574 (15.6)	575,414 (100.0)
1990-97	108,196 (19.7)	80,025 (14.6)	103,768 (18.9)	92,721 (16.9)	76,919 (14.0)	86,978 (15.9)	548,607 (100.0)
TREND		positive**	positive***	negative***	negative***	-	negative**	
TRENDSQ		negative***	-	-	positive*	positive**	positive**	
1976-80	68,670 (34.8)	23,098 (11.7)	40,796 (20.7)	30,085 (15.2)	19,595 (9.9)	15,280 (7.7)	197,524 (100.0)
1981-89	64,737 (32.2)	30,851 (15.2)	41,509 (20.6)	29,204 (14.5)	20,418 (10.1)	14,924 (7.4)	201,643 (100.0)
1990-97	55,080 (26.9)	36,822 (17.9)	43,027 (20.9)	32,078 (15.6)	22,526 (11.0)	15,839 (7.7)	205,372 (100.0)
TREND		negative*	positive***	negative*	negative***	positive***	negative**	
TRENDSQ		negative***	negative***	positive**	positive***	-	positive**	
1976-80	78,906 (47.0)	31,148 (18.5)	26,950 (16.1)	16,005 (9.6)	9,763 (5.8)	5,153 (3.1)	167,924 (100.0)
1981-89	90,091 (47.2)	37,340 (19.5)	32,135 (16.8)	13,812 (7.2)	11,462 (6.0)	6,524 (3.4)	191,364 (100.0)
1990-97	86,974 (45.4)	40,249 (21.0)	35,406 (18.5)	12,220 (6.4)	10,508 (5.5)	6,490 (3.4)	191,847 (100.0)
TREND		positive*	positive***	-	negative***	no trend	positive***	
TRENDSQ		negative**	-	positive**	positive***		negative***	

Note: Shares may not add to 100 due to rounding. *indicates significance at the 5% level, **indicates significance at the 1% level and *** indicates significance at the 0.1% level.

We summarize employment trends for these five industries in Table 6. As in Table 5, we break the study period down into shorter periods that correspond to the business cycle. For each period, the average level of employment and its share of average total employment are reported by Beale category and industry. To provide a basis of comparison, the period averages are also reported for all industries together. The table can be read in two ways. Reading down the columns allows us to see how the industrial structure of the various rural/urban categories has changed over time; reading across the rows provides a perspective on how each industry is distributed across the rural/urban continuum.

During the period since 1976, the level of total Canadian manufacturing employment located in the labour-intensive and scale-based sectors fell, with labour intensive industries declining the most. The level of employment in the natural resource-based, product-differentiated and the science-based sectors rose slightly over the period (see Table 6, last column). The scale-intensive sector paid the highest wages on average; the labour-intensive sector paid the lowest wages on average. Over time, the relative wages in both the labour-intensive and the product-differentiated sectors have fallen compared to the scale-based sector. And the amount of internal restructuring from firm growth and decline has been greatest in the labour-intensive and the product-differentiated sectors.[12]

We turn the discussion now towards describing the specific trends in employment and employment shares by industry. For natural resource based industries, the patterns roughly reflect shifts at the aggregate level; employment shares of the Large Metro and Small Metro areas declined while the shares of the Large Metro Fringe and the two rural classifications increased. Medium Metro's share of employment has remained largely constant (see Table 6).

In labour-intensive industries, we see the typical shift away from Large Metro regions and towards the Large Metro Fringe, which increased its absolute level and share of employment (see Table 6). Nevertheless, the Large Metro and Large Metro Fringe together reduced their employment share from the 1976-80 to the 1990-97 period by 1.8 percentage points. Medium Metro and Nonmetro-Nonadjacent categories increased their employment shares as a consequence. It is worth noting that the increase in relative employment in rural areas was not accompanied by an increase in absolute employment. In absolute terms, none of the smaller metropolitan or rural classifications gained employment.

For scale-intensive industries, where rural areas have a strong presence due to the forest industries, employment-share growth has been strongest in the Large Metro Fringe and Nonmetro-Adjacent categories (see Table 6). These are also the only categories that experienced employment growth over the period. In absolute and relative terms, employment fell in Large Metro, Medium Metro, and Small Metro areas between the 1976-80 and 1990-97 periods.

Large Metro again lost employment and experienced a declining share of employment in product differentiated industries. Gains in employment and employment shares in this sector were concentrated in the Large Metro Fringe and Nonmetro-Adjacent Beale categories (see Table 6).

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[12] Ibid.

The fifth and final broad industry category is science-based industries. The Large Metro areas dominate this sector (see Table 6). As was the case with scale-based industries, this sector is also the one where the Large Metro regions were most effective in maintaining their employment shares. Furthermore, for Large Metro areas, this is the only sector where employment over the period increased in absolute terms. Of the five broad industries, science-based were also remarkable because they are the most urban; rural areas account for less than 10% of employment here. Moreover, employment is increasingly concentrated in the Large Metro Fringe and Medium Metro areas. These two categories combined with Large Metro increased their share of employment from 81.6% for the 1976-80 period to 84.9% for the 1990-97 period. Gains at the upper end of the rural/urban hierarchy in the science-based sector were at the expense of Small Metro areas, which have lost employment and their share of employment.

Now that we have reviewed the shifting locational patterns of these five broad industrial sectors we return to answer the question we posed at the beginning of this section. That is, are we observing a broad-based shift in manufacturing employment or is it more industry or sector specific? Clearly, there has been an across-the-board shift in employment away from Large Metro areas and towards the Large Metro Fringe. Only in science-based industries were Large Metro areas able to increase employment in absolute terms (see Table 6). Employment change in the other rural/urban categories tended to be more idiosyncratic. Medium Metro areas have increased their share of employment in labour intensive and science-based industries, but have reduced their share of scale-intensive employment. Therefore, although the employment share of Medium Metro areas was the most stable between 1976 and 1997, its industrial structure has changed. For Small Metro areas, the share of employment in natural resource, scale-based and science-based industries fell over the period, while Small Metro's share of the other two sectors remained constant. The two rural categories also follow their own paths. Nonmetro-Adjacent regions increased their share of employment across natural-resource, product differentiated and scale-based industries but lost employment shares in the labour intensive and science-based sectors. Finally, Nonmetro-Nonadjacent consistently increased its share of employment in natural resource and labour intensive industries, while it experienced relatively minor share increases in the other sectors.

Overall, it is apparent that within large metropolitan regions, production in every industrial sector has shifted towards the suburbs. Outside of these large centres the pattern is more complicated. No general industry shifts can be identified as driving the relative rise or decline of smaller urban and rural Beale categories. Furthermore, for most industries, there is no apparent shift up or down the rural urban hierarchy. The one exception is science-based industries, which appear to have concentrated over time in the top half of the rural/urban hierarchy.

In summary, during the study period, employment has shifted away from the large metro cores and towards the fringes of these metropolitan regions and rural areas of the country. This general shift parallels trends in the United States (Nucci and Long, 1996 and 1997) and is consistent with broader intra-metropolitan employment trends observed in Canada (Coffey, 1994). Like Nucci and Long, we find that trends in the location of manufacturing employment vary depending on the region in question. Specifically, employment in Ontario has tended to concentrate in the Toronto urban region, especially its urban fringe. In Quebec, the Montreal urban region has experienced a falling share of provincial employment. It is the rural regions of Quebec that have been the most dynamic.

Finally, by breaking employment down by manufacturing sector, it is apparent that there has been a broad shift in manufacturing production across many industries away from the centres of large metropolitan areas and to their fringes. The pattern for other rural/urban regions is by no means as clear. The pattern of change depends on the industry and the region in question.

4.2 Variations in wage rates and labour productivity across the rural/urban hierarchy

Size, using employment or employment shares, provides us with one measure of performance. Other characteristics provide additional information that may be used to evaluate the desirability of an industry. For example, industries differ in terms of wages paid, and therefore, the quality of the jobs provided. They also differ in terms of their labour productivity, which in turn is influenced by, *inter alia*, capital intensity and technologies used.

In order to examine the difference in relative wages paid across the rural/urban hierarchy, we compare wage rates for each Beale category to the national wage (see Table 7).[13] Changes in relative wage rates will reflect changes in industry composition, changes in relative skill levels and changes in relative demand for workers.

The relative wages of production workers differ significantly depending on their location within the rural/urban hierarchy. The spread between the highest and lowest relative wages by Beale category averaged 17% between 1976 and 1997–ranging from a maximum of 22% and a low of 12%. Large Metro and Nonmetro-Adjacent tended to have below average wage levels throughout the study period. Small Metro had the highest wages levels and Medium Metro and Nonmetro-Nonadjacent tended to have wages that were above the national average.

These results are quite different from those reported for the United States. Gale (1997) reports that, in 1992, U.S. core metro areas paid the highest hourly wage and that rural, nonmetropolitan areas paid from 12% to 20% less. In Canada, wages are lowest in the cores of large metropolitan areas and are near the national average in rural parts of the country.

Also reported in Table 7 is a statistical analysis of relative wage trends over time. As relative wages varied considerably across the rural/urban hierarchy, so did their trends. Relative wages in Large Metro and Medium Metro areas fell gradually over time, with Large Metro moving further and further away from the national average and Medium Metro converging with the national average. Nonmetro-Adjacent areas increased from 9% below the national average in 1976 to about the national average in 1997. For all three classifications, these trends were statistically significant. Relative wage rates in the Large Metro Fringe areas, which took employment share away from Large Metro areas, fell initially and then recovered by the end of the study period. This trend reversal is confirmed statistically: TREND is negative and TRENDSQ is positive. Relative wages in Small Metro areas increased through the first half of the study period, but declined to their initial levels by the end. Again, this non-linear trend was confirmed statistically. Finally, relative wage

[13]We use production workers for this analysis.

rates in rural Nonmetro-Nonadjacent areas hovered slightly above the national average over the study period. There was no statistically discernable trend for Nonmetro-Nonadjacent areas.

Table 7. Relative Production Worker Wages in Manufacturing , 1976-1997

Year	Large Metro	Large Metro Fringe	Medium Metro	Small Metro	Nonmetro-Adjacent	Nonmetro-Nonadjacent
	(0)	(1)	(2)	(3)	(4)	(5)
1976	0.94	1.04	1.05	1.09	0.91	1.02
1977	0.94	1.03	1.05	1.09	0.92	1.02
1978	0.94	1.03	1.05	1.09	0.93	1.03
1979	0.94	1.03	1.05	1.07	0.94	1.03
1980	0.95	1.01	1.05	1.07	0.95	1.04
1981	0.95	1.01	1.05	1.07	0.94	1.02
1982	0.94	1.01	1.06	1.09	0.95	1.02
1983	0.93	1.02	1.05	1.10	0.95	1.03
1984	0.92	1.02	1.06	1.14	0.95	1.00
1985	0.92	1.02	1.04	1.14	0.95	1.00
1986	0.93	1.03	1.04	1.12	0.96	1.01
1987	0.93	1.03	1.04	1.11	0.96	1.02
1988	0.92	1.03	1.04	1.11	0.97	1.03
1989	0.93	1.03	1.03	1.10	0.97	1.03
1990	0.93	1.01	1.04	1.10	0.97	1.03
1991	0.92	1.02	1.04	1.09	0.99	1.04
1992	0.93	1.01	1.04	1.10	0.98	1.03
1993	0.92	1.04	1.04	1.08	0.99	1.03
1994	0.91	1.05	1.04	1.08	0.99	1.01
1995	0.92	1.04	1.03	1.09	0.99	1.03
1996	0.92	1.03	1.02	1.10	0.99	1.03
1997	0.91	1.05	1.02	1.09	1.00	1.01
TREND	negative***	negative*	negative***	positive*	positive***	no trend
TRENDSQ	-	positive**	-	negative*	-	

Note: *indicates significance at the 5% level, **indicates significance at the 1% level and *** indicates significance at the 0.1% level.

The differences in wages across urban/rural regions describe the extent to which workers in a given region are generally better off because they receive higher annual earnings. This difference may reflect a number of different factors. It may be because a region generally attracts industries that pay higher wages—or it may be because of a higher wage structure for all industries in that region. To investigate the extent to which industry structure affects wage differences, we graph the average relative wage rate for the period across the Beale categories and the average that is corrected for industry structure in Figure 3. The latter is obtained by following a three-step procedure. The first step is to calculate the average relative wage rate for each industry across Beale codes (using the 5-sector definition). In the second step, each industry's wage is transformed into its relative wage compared to that industry's national average. The final step is to average the result for each Beale code across all its industry sectors. The first two steps effectively provide us with a measure of the degree to which wages vary across Beale codes within industries and the third step provides a summary of these within industry differences for each Beale. Therefore, this procedure provides us

with a measure of relative wages after accounting, albeit in a rudimentary way[14], for across industry wages differences.

When this correction is made, the urban/rural wage profile changes dramatically. The four urban areas now have relative average wages that are slightly above 1, but they are very similar one to another. The two rural areas have relative average wages that are below 1. Thus, once industry characteristics are taken into account, a difference emerges between the group of urban areas and the two rural areas that is more similar to the differences that exist in the United States (see Gale, 1997 and 1998).

The changes that have taken place over time in the relative wages are also muted when the effect of industry is taken into account. In Figure 4, we graph the 'corrected' mean relative wage at the beginning and at the end of the study period. The central core of the urban area still declines, but the fringe increases over time rather than decreases. Both the medium and small metro show a slight decline in their relative wage rate, but the changes are not large. The rural adjacent area still experiences improvements in its relative wage rate. In summary, correcting for industry mix shows that the urban area that was gaining manufacturing employment over this period (the Metro Fringe) also saw an increase in its relative wage compared to the central core area.

Labour productivity provides a second measure of regional performance. The variation in labour productivity across regions reflects a number of factors—differences in capital intensity, differences in the use of advanced technologies, and differences in efficiency. Labour productivity is often seen as a useful performance measure because it speaks to the underlying competitiveness of industries found in various categories of urban and rural regions. Industries that have been growing relatively more quickly in Canada tend to be those with higher labour productivity (Baldwin, Durand and Hosein, 2001).

In order to track the relative labour productivity (RLP) of different areas, we calculate the ratio of the share of value added[15] to the share of production workers and these are reported in Table 8. The lowest and highest levels of RLP, on average, are found in the same areas that had the highest and lowest relative wage rates—Large Metro and Small Metro. Relative wages and productivity differ most for Medium Metro and Nonmetro-Adjacent categories; Nonmetro-Adjacent had below average wages but above average productivity and we observe the opposite for Medium Metro.

Although RLP and wage levels differed across the Beale categories, their trends are similar. The statistical trend analyses in Tables 7 and 8 show RLP and relative wages are moving in the same direction. Large Metro Fringe and Medium Metro areas experienced a relative decline in RLP; Nonmetro-Adjacent experienced an increase. The relationship between relative productivity and wages is confirmed by Table 9, which reports the degree of correlation between relative wage rates and relative productivity for each of the Beale categories over time. In all cases, the correlation between relative wages and productivity is positive, though they are generally not highly significant.

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[14] Similar results are obtained when industrial structure using a shift-share type wage decomposition using a more finely grained industrial classification (Campbell and Brown, 2001).

[15] This uses what is called census manufacturing activity value added, which includes a component of purchased services and, as a result, is not exactly the same as GDP value added.

Figure 3. Relative Production Worker Wages (average 1976-1997)

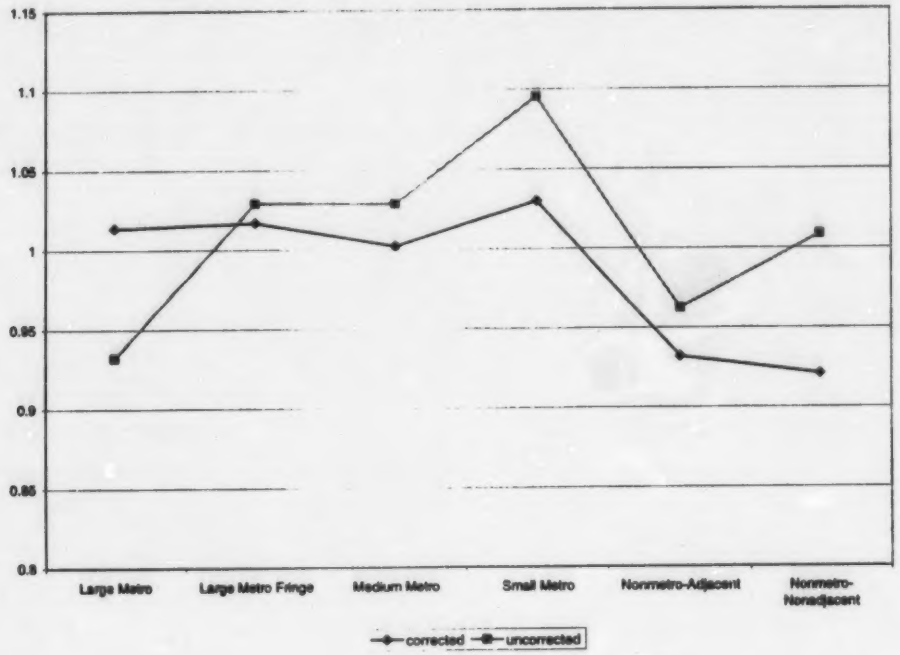
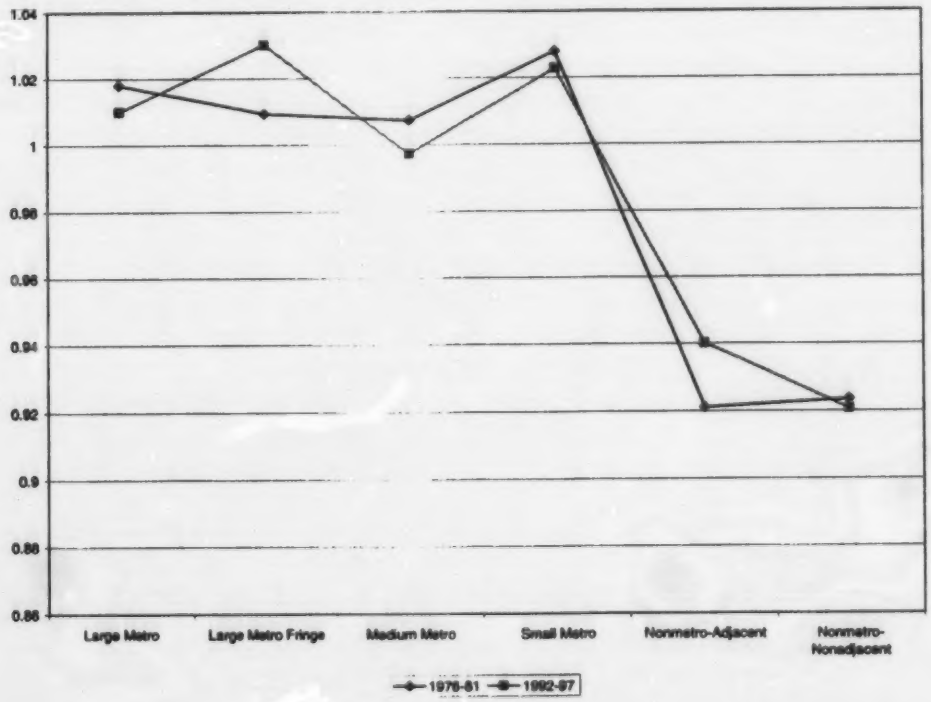


Figure 4. Relative Production Worker Wages, Selected Periods



Differences in relative productivity across urban/rural areas are mainly a function of industry mix. As Figure 5 demonstrates, value added per worker is much more similar across geographic areas within an industry sector than it is across industry sectors. The differences in relative labour productivity outlined in Table 8 may therefore be more a function of differences in industrial structure than differences in capital intensity or differences in efficiency. In order to correct for industry effect, we calculate the RLP for each industry across each geographic region and then average the result for all Beale code regions across all industry sectors. Both the uncorrected and the corrected RLP are plotted in Figure 6. Before correction, the major metro central area has a lower labour productivity than does the fringe metro areas that are gaining employment. After the corrections, there is little difference across the urban areas; however, the nonadjacent rural areas all have lower value added per worker than the urban group. Taking the results on wages and labour productivity together, it may be concluded that rural areas pay lower wages and firms react by adopting technologies that are probably less capital intensive and, therefore, have lower labour productivity.

Table 8. Relative Labour Productivity in Manufacturing, 1976-1997

	Large Metro (0)	Large Metro Fringe (1)	Medium Metro (2)	Small Metro (3)	Nonmetro-Adjacent (4)	Nonmetro-Nonadjacent (5)
1976	0.99	1.05	1.03	1.09	0.90	0.92
1977	0.98	1.06	1.02	1.09	0.90	0.94
1978	0.97	1.09	1.02	1.09	0.88	0.95
1979	0.97	1.02	1.03	1.09	0.93	0.98
1980	0.99	0.97	1.00	1.13	0.91	0.98
1981	1.02	1.01	1.03	1.10	0.88	0.90
1982	1.04	1.05	1.00	1.05	0.92	0.90
1983	0.99	1.07	1.03	1.09	0.93	0.89
1984	0.98	1.03	1.03	1.12	0.95	0.88
1985	0.97	1.01	1.05	1.11	0.94	0.91
1986	0.96	1.04	1.01	1.13	0.95	0.95
1987	0.95	0.96	1.00	1.15	0.98	1.02
1988	0.95	0.95	0.98	1.18	0.96	1.03
1989	0.98	0.94	0.95	1.18	0.98	1.01
1990	1.02	0.95	0.98	1.14	0.92	0.96
1991	1.08	0.92	0.98	1.07	0.93	0.94
1992	1.07	0.95	0.99	1.09	0.91	0.89
1993	1.04	0.98	0.99	1.08	0.95	0.91
1994	0.99	1.03	0.97	1.09	0.98	0.96
1995	0.96	0.99	0.97	1.10	1.01	1.02
1996	0.97	1.06	0.99	1.07	1.04	0.90
1997	0.96	1.08	1.01	1.09	1.00	0.87
TREND	no trend	negative***	negative***	positive***	positive***	no trend
TRENDSQ		positive**	-	negative***	-	

Note: *indicates significance at the 5% level, **indicates significance at the 1% level and *** indicates significance at the 0.1% level.

Figure 5. Relative Value Added per Worker

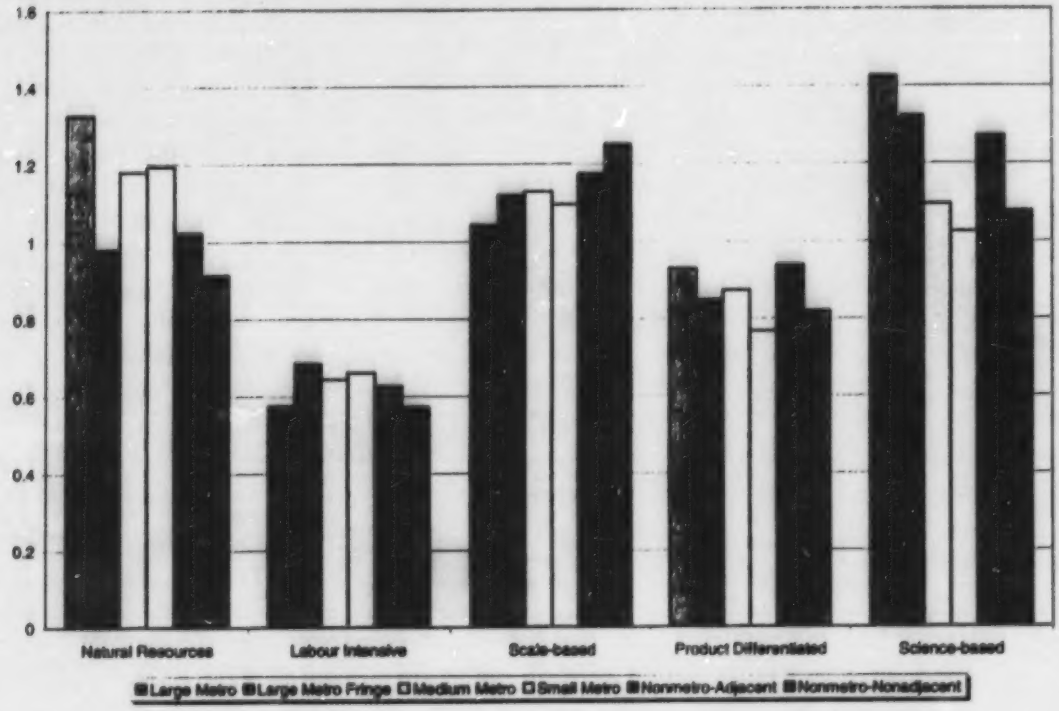


Figure 6. Relative Labour Productivity

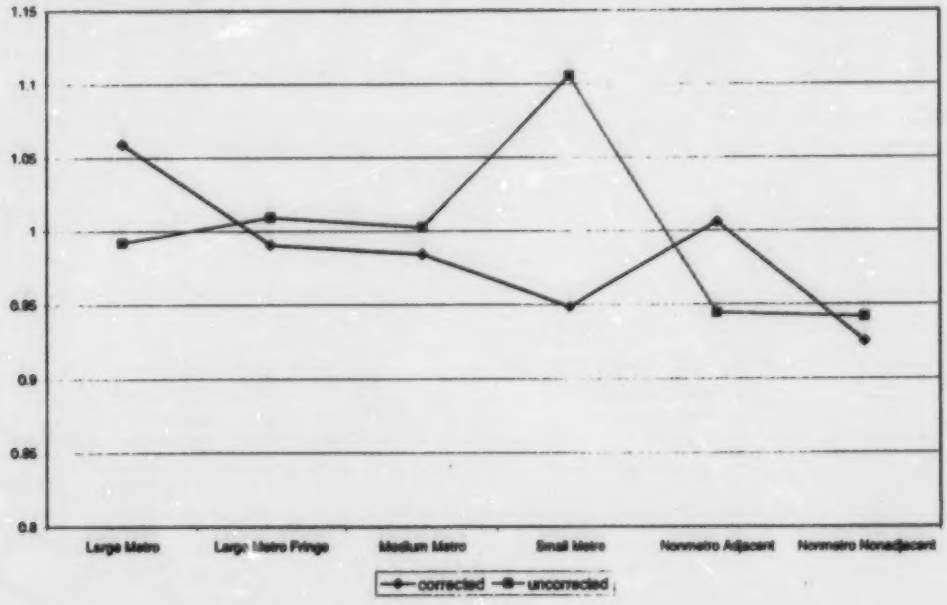


Table 9. Correlation (r) between Relative Wage Rates and Relative Labour Productivity

	Large Metro (0)	Large Metro Fringe (1)	Medium Metro (2)	Small Metro (3)	Nonmetro-Adjacent (4)	Nonmetro-Nonadjacent (5)
R	0.13	0.30	0.51*	0.39	0.72**	0.30

Note: *indicates significance at 5% confidence level and **indicates significance at 1% confidence level.

It is evident that the trends and levels of RLP differ markedly across the rural/urban hierarchy. What we want to ask now is, do we observe the same patterns when RLP is broken down by industry? That is, is it just one or two industries driving changes in RLP or are these trends more broadly based?

Changes in RLP for each sector and Beale classification are summarized in Table 10. Previously we used the business cycle to divide the study period. In this case, we report average levels of RLP for three roughly equal periods of time for each of the industries. Also reported in Table 10 are the results of a statistical analysis of RLP trends over time. We use the same methodology as above.

It is apparent from Table 10 that aggregate trends in RLP reported to this point mask crosscurrents of change at the industrial level. For example, although the aggregate trend for Large Metro is negative, several industries were moving in opposite directions over the study period. Labour intensive and scale-based industries were trending downwards, while product differentiated and science-based industries became more productive relative to the national average. A different story emerges for Large Metro Fringe. In all sectors, there was an initially negative trend, but this trend had slowed for natural-resource and possibly reversed for scale-intensive industries. Therefore, Large Metro Fringe's decline was largely arrested and possibly reversed by change within these two industries. For Medium Metro areas, the overall trend is negative, but at the industrial level scale-based industries appear to be driving this trend. The trends for Small Metro, Nonmetro-Adjacent and Nonmetro-Nonadjacent are also complicated, with industries often moving in different directions or reversing their own initial trends over the study period. In conclusion, trends in RLP across the Beale classifications are not the result of uniform increases or decreases in relative productivity of their industries. There is no apparent structural change that has provided rural or urban regions with an advantage that has uniformly driven their industries' productivity upwards or downward relative to the national average.

Overall, our findings contrast with evidence from the United States. There, labour productivity and wages tended to decline as we move down the rural/urban hierarchy (Gale, 1997 and 1998). In Canada, Large Metro areas are the least productive and pay the lowest production worker wages, while Small Metro areas are the most productive and pay the highest wages. Moreover, the most rural regions of the country pay wages and have industries with productivity levels that are at or above the national average. However, much of the differences in both wage and labour productivity are the results of the industrial structure. After industry structure is considered, rural areas pay lower wages and are characterized by lower labour productivity. Finally, although the relative productivity of rural and urban areas has changed through time, their trends are not uniformly positive or negative when broken down by industry.

Table 10. Relative Labour Productivity, by Industry

	Period/Trend	Large Metro (0)	Large Metro Fringe (1)	Medium Metro (2)	Small Metro (3)	Nonmetro-Adjacent (4)	Nonmetro-Nonadjacent (5)
				period average			
All Industries							
	1976-82	0.99	1.04	1.02	1.09	0.90	0.94
	1983-89	0.97	1.00	1.01	1.14	0.96	0.96
	1990-97	1.01	0.99	0.98	1.09	0.97	0.93
	1976-97	*0.99*	*1.01*	*1.00*	*1.11*	*0.94*	*0.94*
Natural Resources-Based							
	1976-82	1.15	0.95	1.04	1.12	0.83	0.75
	1983-89	1.14	0.86	1.08	1.17	0.88	0.75
	1990-97	1.20	0.82	1.03	1.21	0.84	0.77
	1976-97	*1.16*	*0.87*	*1.05*	*1.17*	*0.85*	*0.76*
	TREND	no trend	negative***	no trend	positive***	no trend	no trend
	TRENDSQ		positive***		-		
Labour Intensive							
	1976-82	0.96	1.18	1.05	1.14	0.94	0.86
	1983-89	0.92	1.15	1.06	1.20	0.97	0.87
	1990-97	0.91	1.06	1.06	1.24	0.98	0.90
	1976-97	*0.93*	*1.13*	*1.06*	*1.20*	*0.96*	*0.88*
	TREND	negative***	negative***	no trend	positive***	positive***	no trend
	TRENDSQ	-	-		-	-	
Scale-Based							
	1976-82	0.97	0.97	1.02	1.05	0.92	1.03
	1983-89	0.91	0.97	0.99	1.09	0.97	1.07
	1990-97	0.87	1.05	0.98	1.06	1.03	1.02
	1976-97	*0.91*	*1.00*	*1.00*	*1.07*	*0.98*	*1.04*
	TREND	negative**	negative*	negative**	no trend	positive***	positive*
	TRENDSQ	-	positive**	-		-	negative*
Science-Differentiated							
	1976-82	1.03	0.99	1.02	0.97	1.00	0.92
	1983-89	1.07	0.97	0.99	0.97	1.04	0.86
	1990-97	1.07	0.99	1.00	0.97	0.99	0.85
	1976-97	*1.06*	*0.98*	*1.00*	*0.97*	*1.01*	*0.88*
	TREND	no trend	no trend	no trend	no trend	no trend	negative***
	TRENDSQ						-
Specialized							
	1976-82	1.05	1.08	0.87	0.97	0.95	0.81
	1983-89	1.08	1.07	0.84	0.97	0.92	0.71
	1990-97	1.15	0.98	0.85	0.75	0.94	0.83
	1976-97	*1.10*	*1.04*	*0.86*	*0.89*	*0.94*	*0.79*
	TREND	positive***	negative***	no trend	positive***	no trend	no trend
	TRENDSQ	-	-		negative***		

Note: * significant at the 5% level, ** significant at the 1% level, *** significant at the 0.1% level.

4.3 Measures of specialization

To this point we have analyzed trends in employment levels, wages and labour productivity across the rural/urban hierarchy. One of the themes that emerged from this analysis is that underneath the slowly evolving aggregate trends in employment (or productivity) are crosscurrents of change at the industrial level. This implies the industrial structure of various levels of the rural/urban hierarchy may be changing over time. One consequence of industrial change is that regions may become more or less specialized. In this section, we present two measures of specialization.

Our first specialization measure focuses on the extent to which an area concentrates on a small number of industries. The *Top Four Industry Concentration Index*[16] ($Con4_i$) indicates that there is a considerable difference in specialization across the urban-rural hierarchy; rural areas tend to have their employment concentrated the most in their top four industries and large urban areas the least (see Figure 7). There also appears to be some convergence over the period; Large Metro areas are becoming more specialized over time and the other Beale categories less so. This is confirmed by the trend analysis presented in Table 11. Large Metro has a statistically significant positive trend and the rest of the Beale categories have significant negative trends. Despite the tendency for concentration ratios to fall, there are still substantial differences between the top and bottom of the rural/urban hierarchy at the end of the period.

Table 11. CON4 Trend Analysis

Beale Code	CONSTANT		TREND		r^2	n
Large Metro (0)	0.1361	(<0.000)	0.0013	(<0.000)	0.70	22
Large Metro Fringe (1)	0.4640	(<0.000)	-0.0020	(<0.000)	0.45	22
Medium Metro (2)	0.3692	(<0.000)	-0.0013	(<0.000)	0.57	22
Small Metro (3)	0.5900	(<0.000)	-0.0046	(<0.000)	0.83	22
Nonmetro-Adjacent (4)	0.6646	(<0.000)	-0.0021	(<0.000)	0.60	22
Nonmetro-Nonadjacent (5)	0.7661	(<0.000)	-0.0020	(<0.000)	0.89	22

Note: p-values are in parentheses.

Specialization was also measured using the *Herfindahl Measure of Concentration*. The Herfindahl index is a broader measure of specialization that the $Con4_i$ index, because it takes into account the entire distribution of employment shares across all industries. The Herfindahl index confirms the findings based on narrower $Con4_i$ index. That is, specialization is inversely and strongly related to a census division's place in the rural/urban hierarchy and there appears to be a trend towards more diversity among the Beale categories and in particular the Nonmetro-Nonadjacent and Small Metro categories (see Figure 8 and Table 12). The one exception to this trend is Large Metro, whose Herfindahl index increased over the period, but only marginally.

[16] Note the industry here is defined at the 4-digit 1980 SIC level, rather than the aggregate industry definitions used in the preceding analyses

Figure 7. Top Four Concentration Index, 1976-1997

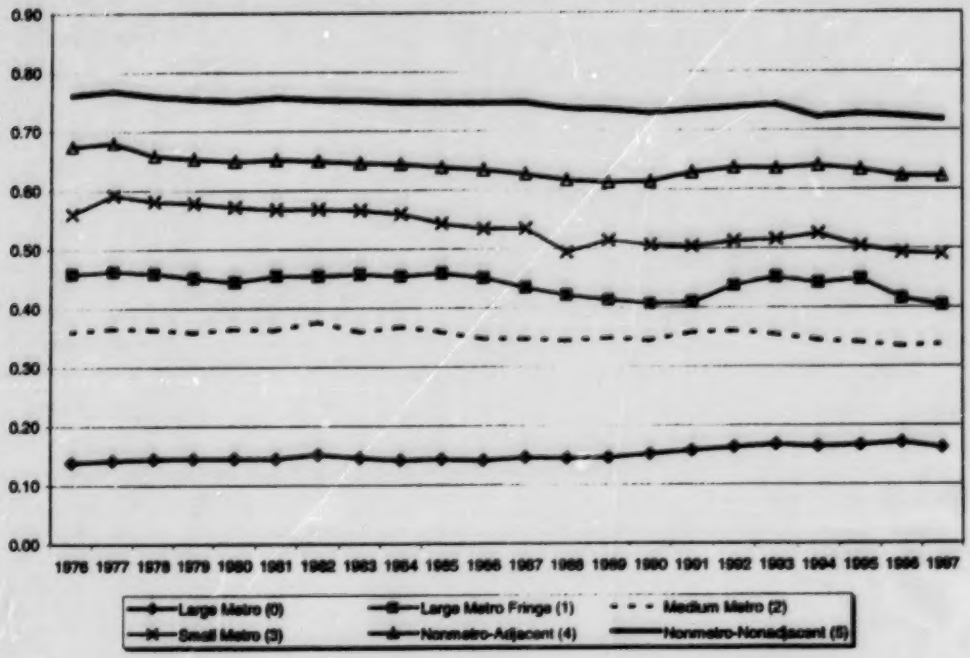


Figure 8. Herfindahl Index, 1976-1997

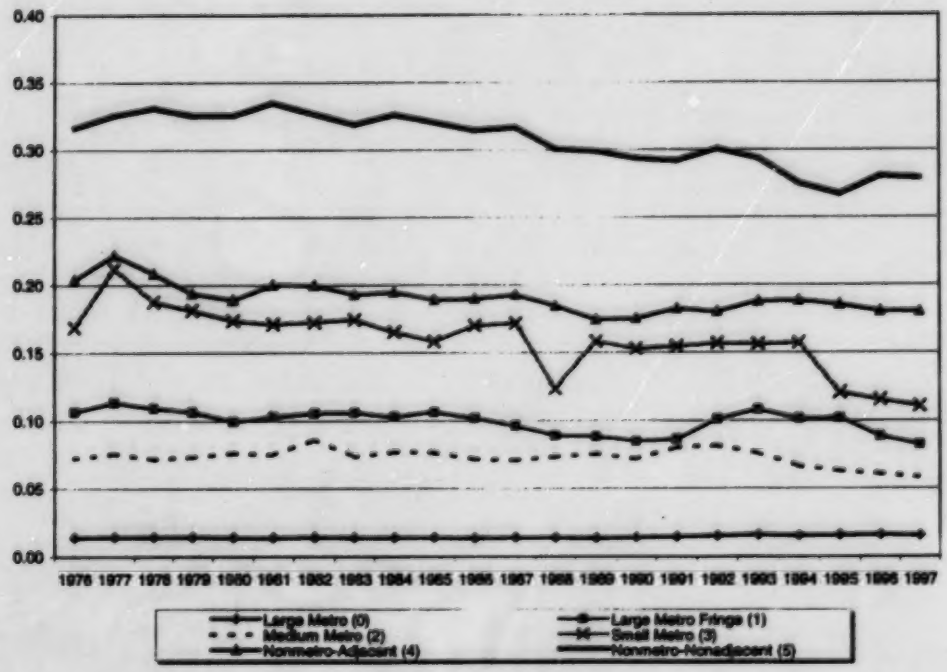


Table 12. Herfindahl Trend Analysis

Beale Code	CONSTANT		TREND		r^2	n
Large Metro (0)	0.0137	(<0.000)	0.0001	(<0.000)	0.44	22
Large Metro Fringe (1)	0.1099	(<0.000)	-0.0009	(0.001)	0.41	22
Medium Metro (2)	0.0788	(<0.000)	-0.0005	(0.025)	0.23	22
Small Metro (3)	0.1945	(<0.000)	-0.0030	(<0.000)	0.66	22
Nonmetro-Adjacent (4)	0.2061	(<0.000)	-0.0014	(<0.000)	0.60	22
Nonmetro-Nonadjacent (5)	0.3397	(<0.000)	-0.0028	(<0.000)	0.82	22

Note: p-values are in parentheses.

To the extent that higher levels of specialization (or higher levels of diversity) imply greater susceptibility to economic shocks, these results suggest that those places lower down in the rural/urban hierarchy are becoming less prone to economic shocks. On the other hand, at the opposite end of the rural/urban hierarchy, there appears to be a greater degree of vulnerability.

4.4 Industry turnover across the rural/urban hierarchy

Measures of industry share change allow us to rank regions on the basis of their instability. In Figure 9, we plot the overall index of share change—ISC index—a measure of industry turnover. The Beale category with the least amount of change is the Large Metro area—with about 4 percent per year. The areas with the highest instability are the rural areas (the Nonmetro Adjacent and the Nonmetro-Nonadjacent)—with rates of turnover generally above 10 percent. There is, therefore, a correlation between industry turnover or economic shocks and the degree of specialization/diversity. The rural areas are more specialized and are more likely to experience changing importance of their industrial structure.

It is noteworthy that the Large Metro Fringe areas experienced as much turnover as the two rural areas. We have previously seen that this group has been growing relative to the central Large Metro areas. This growth has been accompanied by a relatively high instability index, thereby indicating that the growth has changed the relative importance of their industrial structure more than it changed the industrial structure of the Large Metro areas that were in decline.

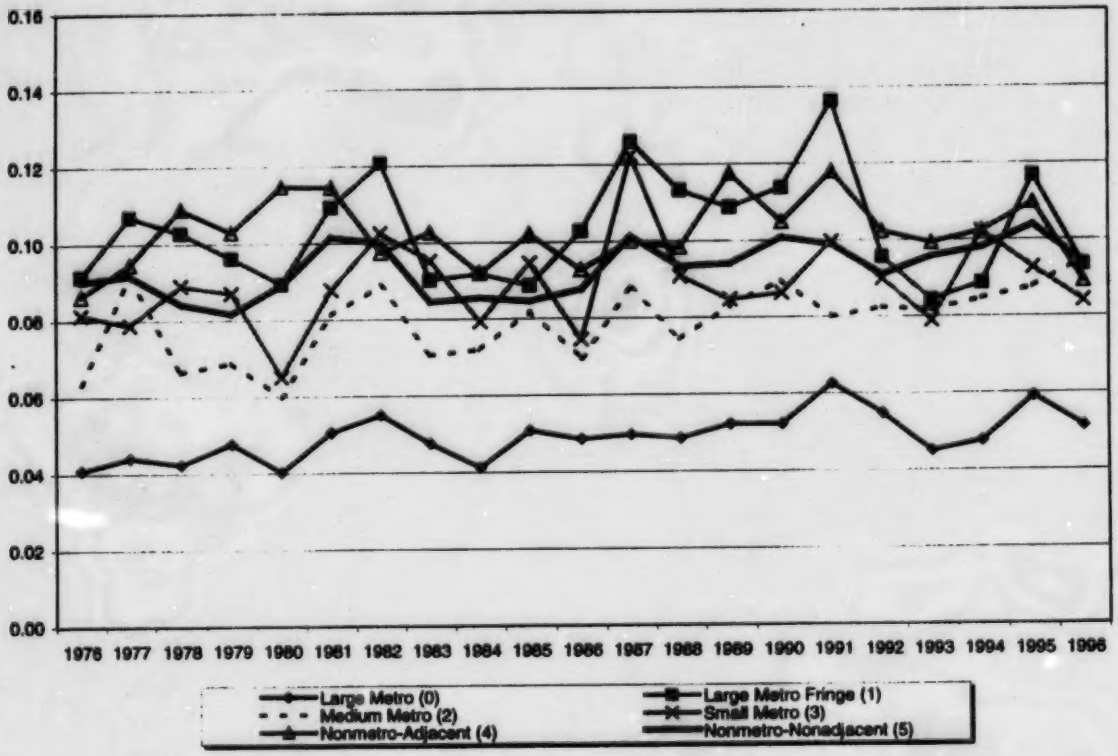
Table 13. ISC Index Trend Analysis

Beale Code	CONSTANT		TREND		r^2	n
Large Metro (0)	0.0430	(<0.000)	0.0006	(0.005)	0.35	21
Large Metro Fringe (1)	0.1005	(<0.000)	0.0002	(0.639)	0.02	21
Medium Metro (2)	0.0691	(<0.000)	0.0009	(0.007)	0.32	21
Small Metro (3)	0.0837	(<0.000)	0.0005	(0.285)	0.06	21
Nonmetro-Adjacent (4)	0.1008	(<0.000)	0.0001	(0.668)	0.01	21
Nonmetro-Nonadjacent (5)	0.0869	(<0.000)	0.0005	(0.021)	0.25	21

Note: p-values are in parentheses.

We also observe an increase in the degree of turnover over the period for several rural/urban categories (see Figure 9). Statistically, there is a significant increase in turnover in Large Metro, Medium Metro and Nonmetro-Adjacent areas (see Table 13). In the other three Beale classifications the trend is insignificantly different from zero. Therefore, there is some evidence that turnover across industries is increasing over time.

Figure 9. Industry Share Change Index



5. *Conclusion*

Between 1976 and 1997, there has been a shift in the manufacturing sector from the central areas of large metropolitan regions towards their suburbs. The general tendency towards suburban employment in these large metropolitan regions was not accompanied by a large shift in employment towards those places further down the rural/urban hierarchy. Nationally, large metropolitan regions experienced a small loss of their share of employment during the study period.

Still, the share of manufacturing employment in rural regions has increased slightly over the study period. This was the result of a declining share of employment in Small Metro areas combined with a slight loss of employment share on the part of large metropolitan regions. Of the two rural regions, the Nonmetro-Adjacent areas increased their share the most. Only in the 1990s did Nonmetro-Nonadjacent areas begin to increase their share of employment. Therefore, as was the case in the U.S., there is some evidence of a shift towards rural manufacturing employment, but this phenomenon has been largely limited to those places in the shadow of metropolitan regions.

Although national trends indicated large metropolitan regions were relatively stable between 1976 and 1997, at the regional level there were large differences in their trajectories. Employment in the Montreal city-region declined as a share of Quebec's employment throughout the study period. The Toronto city-region, on the other hand, increased its share of employment in Ontario. Montreal's relative decline benefited rural parts of the province the most, while Toronto's relative rise was at the 'expense' of Medium Metro and Small Metro areas.

The suburbanization of employment observed in large metropolitan regions occurred across a broad range of sectors. It was particularly strong in natural resource-based, labour intensive and product differentiated industries. Large Metro areas were far better at maintaining employment in scale-based and science-based industries. Employment trends for the other Beale classifications were not as clear. No region exhibits growth across all industries. Labour intensive sectors are generally associated with the decline in central urban areas. But growth therein came from the newer science-based sectors. No one industry then can be identified as driving either growth or decline across all regions.

In Nonmetro-Nonadjacent, relative wages have been at or above the national average for most of the period. In Nonmetro-Adjacent, relative wages started the period by some 8% below the national average, but by the end of the period, the gap had fallen to around 2%. In contrast, the Large Metro Fringe areas that tended to grow in relative size experienced a decline in the relative wage rates. However, most of this change was the result of changing industrial structure. Once the differences in structure are taken into account, wages and productivity differ significantly across the urban/rural hierarchy.

We have also seen that rural areas tend to specialize in fewer manufacturing industries. A small number of industries tends to provide a larger percentage of total employment in rural than in urban areas. Diversification is less closely associated with the importance of change. In urban areas, the percentage of total employment that turns over every year due to the growth and decline of industries is smaller than in rural areas. Only in the Large Metro Fringe is turnover close to that of the rural regions, which possibly reflects the influence of growth on its industrial structure.

Appendix A: A Method for Creating Consistent Geographic Units for Longitudinal Analysis

Background

Statistics Canada maintains a Standard Geographic Classification (SGC) system that provides a geographic framework for analysis. However, the geographic areas described by the SGC are updated every five years, concurrent with the Census of Population. These updates include significant boundary changes and can result in areas being reclassified. Thus, difficulties are encountered when conducting longitudinal analysis since the geographic unit of analysis does not remain constant through time. Therefore, a method for creating a consistent geographic framework is required. The objective of this exercise is to develop a method for assigning 1976 census geography identifiers to all records in a longitudinal database derived from the Annual Survey of Manufactures (ASM) between 1976 and 1997.

Responses to the ASM are collected at the plant level and each plant is assigned a unique identifier (RSN). Matching plant-level records by RSN enables the creation of a longitudinal file that tracks each plant through time. The ASM provides a location for each plant in a given year by ascribing it to a province, county, and municipality, which together comprise an internal coding system referred to as the Manufacturing Geographic Classification (MGC). The MGC is a revision of the SGC adopted by the ASM for operational purposes. Table A1 outlines the differences between the two schemes.

The MGC is the same as the SGC at the province and county level, where the county (MGC) is equivalent to the SGC concept of a census division. The municipality (MGC) is similar, but not identical, to the SGC concept of a census subdivision (CSD).[17]

Census subdivisions undergo frequent and significant boundary changes that reflect Canada's changing political geography at the local level. However, census divisions remain more stable through time. Therefore, census divisions are used here as the unit of analysis since they provide detail at a sub-provincial level, have relatively stable and static boundaries[18], and bridge the differences between the two classification systems. The following section describes the methodology adopted for assigning all plants in the longitudinal file to a census division based on the 1976 census boundary definitions.

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[17] In the MGC, some municipalities are amalgamated whereas in the SGC they are treated as separate entities. Unlike coding for the province and county/census division, the actual codes used in the MGC are not the same as those used in the SGC.

[18] This is true across all of the provinces and territories, with the exception of Quebec. Census division boundaries were redrawn in the province of Quebec between 1986 and 1991 resulting in complete geographic discontinuity between these two census years.

Method

Given the possibility of shifts in geographic boundaries at the census division level, each plant in the longitudinal ASM file can have multiple geographic codes through time. Multiple geographic codes can arise from two possibilities: 1) the plant relocated[19] or 2) there is a change in the geographic structure. In the first instance, the longitudinal record for a plant that relocates (defined as a plant that changes province) was split into two records at the point when a change in province is detected. After controlling for plant relocation, we address the second issue by assuming that the establishment's location in its entry year represents its location throughout the study period. However, this does not solve the problem completely. Using the geographic area assigned to an entrant in its year of birth may not result in consistent geographic units since the SGC changes every five years. For example, a plant entering in 1992 would be assigned to a census division using the 1991 census geography, which may not be consistent with the 1976 census geography.

The majority of plants existed (or entered) at the beginning of the study period and therefore were assigned a location using the 1976 census division definitions. Plants entering prior to 1981 were readily assigned to a 1976 census division since there were no boundary changes made prior to the 1981 Census. Only plants entering in 1981 or thereafter needed to have their location adjusted.

A process for assigning entrants (post-1981) to a consistent geographic structure based on the 1976 boundary definitions was developed by identifying all of the areas where there were census division boundary changes. Since the longitudinal file covers the period between 1976-1997, boundary changes between the 1976, 1981, 1986, 1991 and 1996 Censuses were examined using a geographic information system (GIS) package. This was used to identify changes in the spatial limits of census division boundaries. It was found that there were no significant changes in the geographic hierarchy at the census division level between the 1976 and 1981 Census. Therefore, adjustments only needed to be made to plants entering in 1986 and thereafter.

Boundary changes that have taken place at the census division level for each census year (1986 and beyond) were identified on a province-by-province basis since the census division also represents a sub-provincial level of political jurisdiction in most provinces. Based on these boundary changes, a set of rules for assigning 1976 census divisions to establishments entering in 1986 or thereafter were developed. The majority of the provinces and territories require no adjustments (Table A2).[20] Rules were developed to address boundary changes in Quebec, Ontario, Alberta and British Columbia. In all other provinces and territories, regardless of year of entry, the assigned census division can be treated as the 1976-equivalent census division. Elsewhere, a number of strategies were used to

[19] In the ASM, a plant is assigned a new RSN if two of the three following conditions are met: a) there is a change in ownership; b) there is a physical relocation of the plant; and c) there are significant changes in the output of the plant resulting in industry reclassification. Therefore, not all plant relocations are accounted for in this exercise. Since this study is predicated upon the geographic location of plants, additional changes are made to improve locational accuracy.

[20] Some boundary changes were considered too small to make a difference. For example, census divisions in the Northwest Territories were redrawn but most of the reallocated area was part of Great Bear Lake. Other boundary changes included corrections to the cartography, as well as some municipal boundary changes. If census subdivision level data were available, some of these changes could have been implemented.

generate 1976-equivalent census divisions depending on whether census divisions were split, amalgamated, or otherwise changed. These strategies are described in detail in the following sections.

a. Census-Division Splits

The first type of geographic change involves the splitting of census divisions after 1981. In this scenario, large census divisions are divided into two or more smaller census divisions (Figure A1). This occurred in Alberta and British Columbia. Therefore, census divisions are adjusted for some entrants between 1986 and 1997 to account for the splitting and renumbering of census divisions (Table A3).

b. Census-Division Amalgamations

The second type of geographic boundary change involves the amalgamation of census divisions after 1981. In the absence of census subdivision level data, this is more problematic. It is difficult to assign a plant to an original census division, since there are multiple possibilities. Due to this limitation, this is the only case where 1976 boundaries are cast forward to their 1986 equivalent. There are only three areas in eastern Ontario where regional restructuring resulted in the amalgamation of census divisions (Table A4; see for example Figure A2).

c. Census-Division Restructuring—British Columbia and Quebec

The third type of geographic boundary change occurs when there are changes to census division boundaries that do not follow existing census division boundaries (Figure A3). This type of geographic restructuring requires a different approach and is applied only to a portion of British Columbia and across all of Quebec.

In British Columbia, the boundaries in the Vancouver area were significantly redrawn between the 1986 and 1991 Censuses. Therefore, entrants between 1991 and 1997 in these areas could belong to a number of 1976-equivalent census divisions and—in the absence of census subdivision level data—it is difficult to identify to which 1976 census division they belong. Table A5 shows the possible equivalents for each area where there were boundary changes. To overcome this problem, the postal code associated with each of the plants was used; this process is described in more detail below.

The problem is more extensive in Quebec. Census division boundaries across that province were significantly redrawn between the 1986 and 1991 Censuses. There were no major boundary changes between 1981 and 1986 in Quebec. Therefore, census divisions assigned to plants entering Quebec prior to 1991 can be used as the 1976-equivalent census division. The postal codes for all plants entering in Quebec in 1991 or thereafter were used to assign 1976-equivalent census divisions.

Postal code information for entrants in the specific regions of British Columbia (Table A5) and Quebec was derived from a physical location file maintained by the ASM that tracks each plant location.[21] These postal codes were linked to geographic co-ordinates (latitude, longitude) using Statistics Canada's postal code conversion file (PCCF).[22] These geographic coordinates (with postal code identifiers) were then plotted using a desktop GIS package. These points were then overlaid with the 1976 Census Division boundaries to identify the 1976 Census Division in which they were located (Figure A4).

It should be noted that there are some data quality issues associated with the physical location file. Some of the records had invalid postal codes or had postal codes that suggested the plants were located in another province or country. In this very small number of cases, an imputation method was used based on the census division assigned upon entry. That is, all other records that were assigned to that census division in that year were examined to identify their 1976-equivalent census division. The plant with the invalid postal code was then assigned a 1976-equivalent census division based on where the majority of the other plants in the same census division were allocated using the 1976 geographic structure.

In addition to data quality issues, there are some errors associated with using postal codes. Postal codes are most accurate within urban areas, where a postal code usually represents one side of a street block. In rural areas, postal codes can represent a wider area; therefore, the point location assigned to the postal code does not represent the exact physical location of that postal code (see Statistics Canada, 1997c). However, the probability of the postal code location being correct in rural areas increases when linked with larger areas (such as census divisions).

[21] While the physical location file could have been used to address some of the other problems described above, there are some issues regarding data quality. This is discussed in more detail below. The magnitude of this problem is minimised by using the postal code only after considering all other options.

[22] While the PCCF provides a link between each postal code and its position within the census geography, it is only linked to the most recent census geography. However, the PCCF also provides coordinate information that enables us to map these to other vintages of census geography.

Table A1. Comparison of Geographic Classifications

Standard Geographic Classification (SGC)	Manufacturing Geographic Classification (MGC)
Province	Province
Census Division (CD)	County
Census Subdivision (CSD)	Municipality

Table A2. Census Division Adjustments by Province

SGC Code	Province / Territory	Adjustments Required
10	Newfoundland	No
11	Prince Edward Island	No
12	Nova Scotia	No
13	New Brunswick	No
24	Quebec	Yes
35	Ontario	Yes
46	Manitoba	No
47	Saskatchewan	No
48	Alberta	Yes
59	British Columbia	Yes
60	Northwest Territories	No
61	Yukon Territory	No

Table A3. Census Division Adjustments for Splits and Renumbering

Entry years	Original SGC Code		1976 SGC Equivalent	
	Province	Census Division	Province	Census Division
1986-1997	48	17	48	15
1986-1997	48	18	48	15
1986-1997	48	19	48	15
1986-1997	48	15	48	09
1986-1997	48	08	48	08
1986-1997	48	09	48	08
1991-1997	59	59	59	55
1991-1997	59	55	59	55

Table A4. Census Division Adjustments for Amalgamations

Entry years	Original SGC Code		1986 SGC Equivalent	
	Province	Census Division	Province	Census Division
1976-1985	35	02	35	02
1976-1985	35	03	35	02
1976-1985	35	01	35	01
1976-1985	35	04	35	01
1976-1985	35	05	35	01
1976-1985	35	07	35	07
1976-1985	35	08	35	07

Table A5. Census Division Restructuring in British Columbia

Entry years	Original SGC Code		Potential 1976 SGC Equivalent	
	Province	Census Division	Province	Census Division
1991-1995	59	15	59	11
1991-1995	59	15	59	15
1996-1997	59	15	59	11
1996-1997	59	15	59	13
1996-1997	59	15	59	15
1996-1997	59	09	59	09
1996-1997	59	09	59	11
1996-1997	59	09	59	13

Figure A1. The splitting of census divisions in northern Alberta and British Columbia

Figure A2. The amalgamation of Census Divisions in eastern Ontario

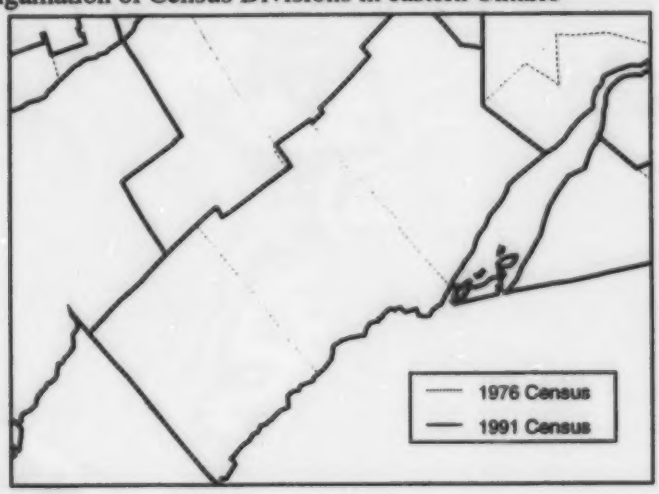


Figure A3a. Census divisions in the Montreal area using the 1976 boundary definitions

Figure A3b. Census divisions in the Montreal area using the 1991 boundary definitions

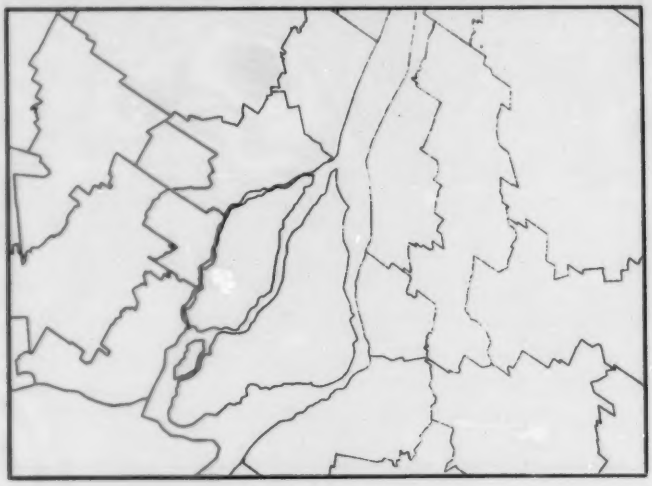
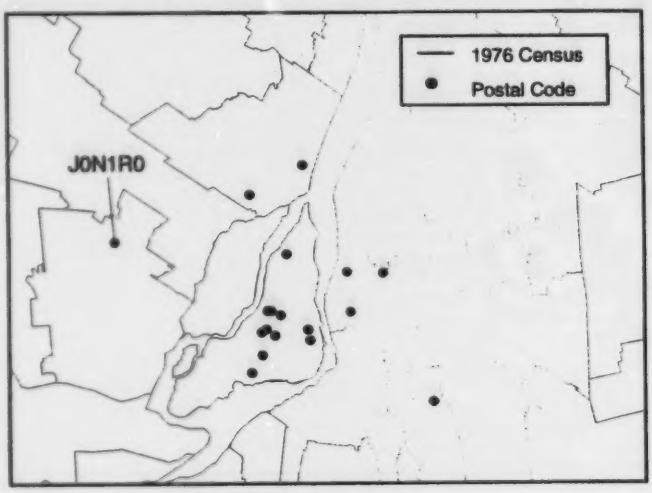


Figure A4. Plotting the coordinates of postal codes to assign them to 1976 census divisions in the Montreal area



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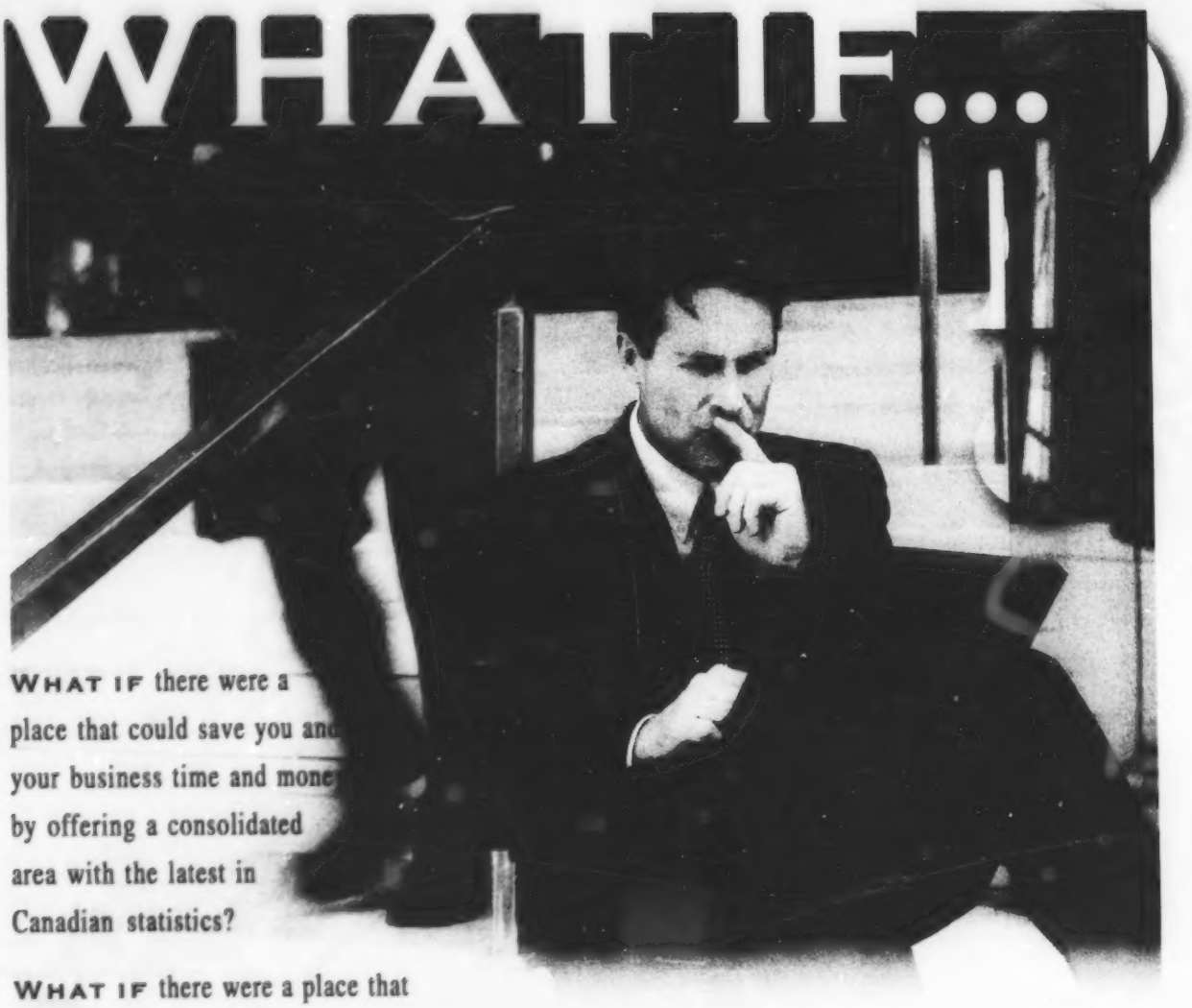

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